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OF THE

# ROYAL SOCIETY OF MEDICINE

Vol. XXXV. No. 6. April, 1942.

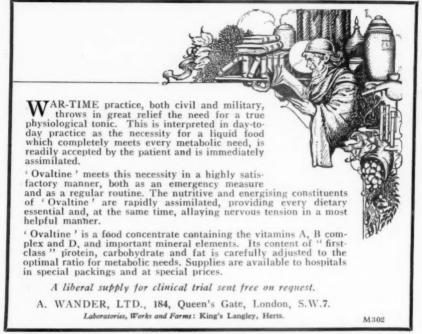
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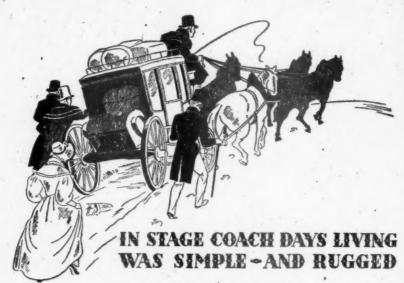
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# Section of Physical Medicine

President-Major G. D. Kersley, R.A.M.C.

[February 20, 1942]

# Psychological Aspects of Rheumatoid Arthritis

By JAMES L. HALLIDAY, M.D.

This paper describes the results obtained by applying a psychological approach to a series of 20 unselected patients with rheumatoid arthritis—14 females and 6 males.

A. PSYCHOLOGICAL CHARACTERISTICS OF PERSONS WHO DEVELOP RHEUMATOID ARTHRITIS (In collaboration with K. M. Abenheimer)

(i) On Looking at the Patient

The facies.—Textbooks describe in detail the appearance of the joints but are unanimously silent on the appearance of the patient as a person. Yet even a superficial observer on entering a waiting-room occupied solely by patients with rheumatoid arthritis, would probably receive an impression that they were on the whole, "a quiet, decent-looking lot". Possibly also, he might note that there seemed to be a dominant type of facial expression, but he would find it difficult to describe this in words. In the case of women patients my notes show a prevalence of such terms as "calm; detached; placid; pleasant, 'with little smiles'". In the male patients, the terms varied from "expressionless and blank" to "open and bright". Katz (1931) was so fascinated Katz (1931) was so fascinated by the facies of rheumatoid patients that he suggested it could be compared to "a mask face" such as is found in chronic Parkinsonism—but this is doubtful and was not my impression. There is certainly a relative poverty of facial expression but this is probably not more evident than might be expected in the case of persons who habitually hide and repress many aspects of their inner emotional life. Irrespective of its explanation—and there may be a central nervous organic basis—the prevailing facies in rheumatoid arthritis with its calmness, detachment, and lack of exteriorized tension, is in definite contrast to that in many osteo-arthritics where the countenance is anxious, strained, irritable, dazed or depressed, i.e. shows evidence of an anxiety or depressive state. Indeed, one of my medical colleagues considers that the contrast is a point of value in differential diagnosis.

Behaviour and manner.—As regards behaviour, the patients sat calmly and quietly while being questioned and did not fidget or squirm or show obvious "nervous" movements. In the females the manner could often be described as "soft and refined" and in the males there was an unusual absence of truculence amounting almost to gentleness. Towards the examiner the general attitude of both sexes was one of quiet friendliness which, during succeeding interviews, did not vary—an observation made originally by

Comment.—These descriptions of the prevailing facies and manner in rheumatoid arthritis did not fit exactly in every case, but they were applicable to the majority and would seem to be fairly distinctive for a group of rheumatoids as contrasted with groups of other affections, e.g. peptic ulcer. A question arises here: Are the "typical" facies and behaviour in rheumatoid patients to be regarded as characteristics of the persons before the onset of the disorder, or as symptoms, or features, of a generalized morbid process? In other words, do the facies and behaviour belong to the Personality Type, or to the Disease? As the patients were seen only after the onset of the affection, a dogmatic answer is impossible, but in view of the psychological findings (which follow) it seems likely that the facies and manner are expressions of the personality and may therefore be regarded as characteristics which may, or may not, have become exaggerated during the progress of the rheumatoid illness. Compare the "typical facies" of the peptic ulcer patient which becomes more distinctive after the primary onset and deepens with the chronicity of the disorder.

### (ii) On Talking to the Patient

Strength of character.—The patients did not strike me as being particularly "strong" characters—to use this term in its everyday significance. On the other hand, they were not exceptionally "weak characters".

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Moods.—Most of them described their prevailing moods before the onset of the illness as "cheerful, even-tempered and not the kind that worries", but four of the twenty patients had suffered from periodical depressions. After the onset of illness the majority remained "cheery" but a few admitted to having developed fits of depression when they looked at their joints and brooded on their deformity and incapacity. The relative absence of depression in these patients is in striking contrast to its frequent presence in patients with other affections, e.g. mucous colitis (White, Cobb and Jones 1939). The unusual quality of mood in rheumatoids was noted by Katz who depicts both their "euphoria" (as he calls it) and their depressions as "void of affect—without soul—which produces an effect of truly touching patience".

Social adjustment.—All the patients had been fairly well adjusted to social life in relation to career and occupation. None had held any outstanding position or showed outstanding capacities although one, a domineering hysterical woman, was the president of several women's associations in the small town where she lived. As workers, the majority were fairly active, were reliable and conscientious, and had held the same position for a long time. Even after onset they were little inclined to give in, and in spite of pain they carried on working as long as was humanly possible. This disregard for pain as well as their conscientiousness in work seems to be part-expression of a general tendency which may be described as one of self-limitation and restriction of feelings and emotions. These features are more strikingly illustrated in relation to other fields of life, thus:

other fields of life, thus:

(a) Sex.—Of the 14 female patients 8 professed to be either frigid or "not interested" in sex and their life-histories seem to corroborate this. Of the 6 males 3 were markedly fixed to the mother or sisters.

(b) Childhood.—In most cases the tendency of self-restriction had already developed in early childhood. The majority described at least one of their parents as strict or hard and they had to conform to his or her strict discipline. As children these patients were shy and retiring and at school were only moderately successful.

(c) Later life.—At the onset of illness 6 of the 14 women were living alone with old or invalid relatives whom they attended and for whom they made considerable sacrifices in money, work, comfort and freedom. They fulfilled these social duties as conscientiously as their business ones. The majority of the patients led a quiet life and were essentially "home birds". They had few friends and, being self-sufficient, they found it difficult to make friends but after establishing the relationship they were loyal to it.

(d) Habits.—The patients with perhaps one exception were markedly orderly, punctual, tidy or over-cleanly; that is to say they may be described as showing marked "obsessional trends" (this does not mean they showed full-blown obsessions), as is usual with people who control and restrict their emotions.

# (iii) The Rheumatoid Personality

The psychological characteristics common to all persons in this series were marked emotional self-restriction (present in all cases and often suggested in the facies and manner) and marked obsessional trends (with perhaps one exception).

This self-limiting, emotion-inhibited, rather independent (but passively so) type of personality is not infrequent and may be found associated with various psychosomatic disorders. As thus crudely defined it cannot be regarded as specially related to rheumatoid arthritis in the way that the "allergic personality" and the "peptic ulcer personality" seem to be related to their respective affections. Indeed, from the common-sense point of view, most of the rheumatoid patients could be described as "normal" in that their self-restricting characteristics neither immediately unfitted them for life nor rendered them acutely unhappy. It remains to be seen whether further research will uncover a more specific rheumatoid personality type.

Note.—The patients did not conform to any "psychiatric disease type". Thus—some were markedly hysterical; some were over-scrupulous obsessionals with a tendency to worry; some suffered from phobias. Three of the patients were nail-biters; one had a history of enuresis; and one female patient who had frequent crying fits was on the verge of a melancholic breakdown owing to the absence of any reliable relationship to inner or outer love objects. The unsuitability of such classifications for studies in personality was noted by White, Cobb and Jones (1939) in their study of mucous colitis where they note that "classifications of persons in terms of these psychological reaction patterns fail to indicate personality". Another unsuitable classification is that of Kretschmer which was adopted by Ellman and Mitchell (1936) who examined a series of 50 patients with rheumatoid arthritis and reported that "Schizoid features with marked morbid anxiety predominated in more than half the cases before onset". Kretschmer's schizoid personality would seem to include the self-limiting emotion-inhibited type found in rheumatoid arthritis but the term is, inter alia, too vague and too wide to indicate in communicable form, the fairly well-defined and recognizable type of person who develops rheumatoid arthritis.

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# B. THE PRECIPITATING EMOTION

In 9 of the 20 patients in the series, a definite upsetting event anteceded, and seemed to be connected with, the primary emergence of rheumatoid symptoms. External events which precipitated recurrences were noted in 7 cases.

The nature of the emotions associated with onset or recurrence was in no way specific. The emotional disturbances included shock following acute danger (e.g. air raid; assault by a handbag snatcher), anxiety over finance or the misbehaviour of relatives; fears of loss of a love-object or depression after its loss; paranoid resentment concerning superiors; frustration at being jilted, &c. However, irrespective of its nature, all the patients dealt with the precipitating emotion in a common way, namely, there was failure or incapacity to give it a liberating expression and "the feelings" were, so to speak, bottled up. This restriction of feeling and of emotional expression has already been noted as a typical characteristic of rheumatoid patients.

# C. OTHER PSYCHOLOGICAL CONSIDERATIONS

### (i) Gains from the Illness

There was no evidence that the illness served the purpose of the patient either consciously or unconsciously. After the onset there was no indication that any "secondary gain" (such as compelling others to give attention to the patient) was being aimed at. Also, so far as could be determined, there was, after the onset, no easing of pre-existing psychological tensions in the sense that the arthritis was being experienced as a punishment for, or as a relief from, feelings of guilt.

# (ii) Symbolism

There was no evidence that rheumatoid arthritis could be regarded as symbolic in the strict sense of signifying some particular wish, impulse or emotion, and no connexion could be established between the precipitating emotion and the site or sites of the rheumatoid manifestation.

It is admittedly tempting to regard the locomotory limitations of rheumatoid arthritis as a bodily expression of the self-restricting psychological characteristics. Thus Jelliffe (1936) in discussing the role of aggressive impulses in somatic disease suggested that the criminal who expresses his aggressions outwardly is "locked up by others" whereas the arthritic, who expresses his aggressions inwardly, "locks himself up". This, however, is a fanciful conceit.

# (iii) The Ætiology of Recovery

Rheumatoid arthritis is one of those affections such as peptic ulcer, mucous colitis, exophthalmic goitre, and asthma, which are characterized by phases of crudescence, subsidence and recurrence. The primary phase may be of varying duration and severity and may subside never to recur; or it may continue in severity and assume a progressive fulminating quality; or it may be followed by a period of quiescence of no standard length to be followed by a recrudescence of no constant duration. In other words, irrespective of any treatment applied, there exists the phenomenon of natural recovery brought about by forces within the patient. Nothing, however, seems to be known of the ætiology of such natural recovery apart from certain observations relating to subsidence during pregnancy or jaundice, yet further study of those patients who recover "on their own should be highly profitable. In the short series under review, this aspect was unfortunately left largely uninvestigated from the psychological viewpoint and no comments can therefore be made on how far natural recovery is influenced by improvement in the life situation or in the providing of the patient with a new end in view.

A case may be quoted. A young man, deeply attached to a younger sister developed rheumatoid arthritis in February 1940 within a month after learning that his father had a tumour of the lung and within two weeks of a serious accident to his favourite sister. Phases of activity continued until March 1941 when he began attending the clinic for gold treatment and massage. He made a spectacular recovery in April. Yet this recovery coincided with the recovery of his younger sister who was successful in obtaining a situation and also with his own appointment to the position of It is evident that further research on the ætiology of recovery requires to take full account of the psychological factors involved.

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[March 20, 1942]

# DISCUSSION ON OCCUPATIONAL THERAPY

Mr. J. Rhaiadr Jones (Derwen Cripples' Training College, Oswestry), Hon. Adviser in Rehabilitation to the Minister of Health: Occupational therapy is one branch of the general scheme for the rehabilitation of the injured. Professor Jefferson and Dr. Riddoch in a memorandum on the subject say: "Rehabilitation is the planned attempt under skilled direction by the use of all available measures, to restore or improve the health, usefulness and happiness of those who have suffered an injury, or are recovering from a disease. Its further object is to return them to the service of the community in the shortest rime."

Technically, the work which would be included within this definition of rehabilitation would be: (1) Active movements: (a) Without apparatus; (b) with apparatus (gymnasia and simple games). (2) Massage and electro-therapy: (3) (a) Physical training; (b) organized games—indoor and outdoor. (4) Occupational therapy: (a) Handicrafts at bedside; (b) work out of doors (such as gardening); (c) workshops where handicrafts such as carpentry, weaving, &c., can be practised. (5) Vocational training of those who, because of their residual disability are unable to return to their pre-accident or pre-disease form of employment.

Rehabilitation becomes of the utmost importance in war-time, when it is essential that the patient should be restored to full working capacity as soon as possible.

The main difficulty in the practice of occupational therapy in peace-time is an economic one, and this applies generally to most forms of rehabilitation. In peace-time it is impossible for the average hospital to allow one of its beds to be occupied by a patient until he is able to return direct to his normal occupation. The patient, in order to make room for a more urgent case, has to be discharged to his home, and convalescence becomes a tedious business—he is left to his own devices and the monotony is only broken by periodic visits to the Out-patient Department for general supervision, or for any further treatment. In the case of fractures, this is particularly unfortunate. Patients are put into plaster, kept a few days in hospital and then discharged to their homes, and the time which should be used in maintaining general physical fitness is spent in idleness and boredom.

The economic position of the individual is also of paramount importance in any scheme for rehabilitation. Service cases who are transferred to hospital for treatment suffer no financial loss, their personal allowances and their family allowances do not alter, so that successful treatment is not complicated by financial worry and anxiety. Very different is the position of the non-Service case. Physical misfortune is followed by serious diminution of weekly income, with consequent anxiety as to the well-being of dependants. Why the same reasons which call for the rapid return of the injured to employment in war-time should not apply with equal force to peace-time procedure, is a problem which one feels is bound up with the whole question of the incidence of unemployment, but there can be no justification for a system which eases the unemployment problem by prolonging the period of treatment of the injured.

The Ministry of Health in its attitude towards occupational therapy lays down the principle that it should be primarily remedial and not vocational. In many E.M.S. hospitals workshops have been established where different types of handicrafts can be practised and treatment commences as soon as possible after the injury.

The type of patient to be treated falls into one of two categories: (1) Remedial; (2) psychological and diversional. The remedial case is usually sent by a surgeon with the object of increasing the function of a limb by suitable occupation, and I would suggest that a particular exercise, if allied to production, is likely to prove more efficacious than an active movement where no effort on the part of the brain is involved.

On the stationary bicycle as used in massage departments a patient pedals until he has travelled a certain distance as shown on a clock fixed in front of the machine, or until he has attained to a given speed. In the occupational therapy department, precisely the same result can be obtained by the use of the bicycle fret-saw, on which the patient pedals and, at the same time works a fret-saw which gives both his brain and his hands employment. Many similar instances could be cited but in all, the general idea of production being allied to the necessary remedial endeavour, is the guiding principle.

Occupational therapy has also a definite value from the psychological point of view, and where the facilities are available every case, whether bed or ambulatory, should be given some occupation. Its usefulness in the treatment of all types of cases, in particular the long stay case, cannot be denied. Boredom is not a state of mind which helps either the physician or surgeon to obtain quick results. It is often said that occupational therapy is most useful after a patient is able to get out of bed and needs somewhere to go and

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something to occupy his time. On the contrary, it is to-day generally accepted, that rehabilitation should commence as soon as possible after the patient has been admitted to hospital. In particular this is true of the accident case. The sooner a patient can be brought to realize that his injury, however severe it may be, does not mean the end of everything for him and that he is able, even while lying in bed to undertake some useful work, the more rapid and the more complete is his recovery likely to be. It is important, therefore, that the principle of occupation as soon as possible, should be practised in all hospitals and in particular those which deal with trauma.

# Cost of Occupational Therapy

The cost of an occupational therapy department to a hospital, over and above the cost of providing suitable accommodation is not great. The heaviest annual cost is for salaries of the trained occupational therapist and of the assistants which she may require and I would here stress the necessity of putting the department under a really competent person. The average salary of the trained occupational therapist is in the region of £250, and it has been found that one person can handle quite a large number of cases particularly if they can find voluntary helpers. In normal times, the prime cost of the necessary equipment for a hospital of 400 beds, should not exceed £300.

As far as materials are concerned, the most satisfactory method is for the material to be sold to the patients at its cost price. When the patient has bought the material for the article he is making he is likely to put his best work into it if, when it is completed, he is to be the owner. I strongly deprecate any effort to get patients, even though it be part of their treatment, to make articles which are afterwards sold for the benefit of the department or the hospital concerned. Our experience has been, that not only is it easy to persuade the great majority of cases to undertake occupational therapy, but that once they have started, it is most difficult to keep them out of the workrooms.

One cannot, in dealing with occupational therapy ignore the question of vocational training with which it should be closely allied. Up to quite recently, it was nobody's business to be interested in the future of the injured person as far as his re-absorption into industry was concerned. The Ministry of Labour in conjunction with the Ministry of Health has now set up a scheme, whereby they are able to get in touch with the case before discharge from hospital. At the moment the scheme is only working in connexion with the orthopædic and Fracture A hospitals. Each of these special hospitals is linked up with the Ministry of Labour office in its own area. Before leaving hospital a representative from the Labour Exchange interviews both the man and, if possible, the doctor in charge of the case. In the event of a man being unable to follow his former type of employment because of his residual disability, he is given the opportunity of going to a Ministry of Labour Training Centre where he will be trained for some other occupation more suited to his disability. The admission that it is possible to train many of the physically disabled in the same establishments as the normal individual, is a great step forward and it is to be hoped that its scope will be greatly extended in the post-war period, when the necessity of the greatest use being made of all available man-power to repair the ravages and wastages of war, will be of paramount importance.

Vocational training affects two quite different classes of individuals and there are a few institutions in the country which dealt with this type of training in the pre-war years. One dealt with the adolescent, whose residual disabilities were due to disease (polionyelitis, spastic paraplegia, tubercle, &c.). In the majority of cases, the individual concerned had never worked, knew nothing of industrial conditions and was often firmly convinced that he, or she, was never likely to have any wage-earning capacity. Of this type of institution, the largest (The Derwen Cripples' Training College, Oswestry), with approximately 220 beds, was founded fourteen years ago, and experience has amply justified its existence. In this type of training school the course must necessarily be long and the period in practice is from three to four years.

The other type of institution, of which the best known is the Cripples' Training College at Leatherhead, deal chiefly with the industrial cripple, that is the cripple who has already been in industry but who, owing to accident, is unable because of this residual disability, to return to his previous employment. The system of training in this type of centre involves a much shorter period of instruction, usually not more than six to nine months, and it is run more on the lines of the Ministry of Labour training schemes. It is the latter type of training which will doubtless receive most attention in the post-war years.

For those cases left with a residual disability which makes their reabsorption into normal employment a difficult problem, the older idea was that every such person should be given a pension, thus leaving employment to the able-bodied. Why the physically disabled should be consigned to idleness and a compulsory early retirement for the benefit of the able-bodied when, given the opportunity he is not only willing but able to earn his own

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livelihood, is one of those things which one finds it difficult to excuse in a more or less civilized community.

Another suggestion is that there should be reserved occupations, in which only the physically disabled should be employed, or to put it more exactly, trades in which the able-bodied should not be employed if there were a physically disabled person available who could do the work. This seems to be a more reasonable solution than the first, but there are many difficulties in its adoption, not the least of which would be to decide on the degree of physical disablement for entry into the suggested reserved employment. One feels that, if the physically disabled is to be brought to feel that he is not a burden to society, and if he is to lead a normal and happy life, he must be placed in a position where he can have equal opportunity of employment in those trades for which he is best

There are, unfortunately, a relatively small number of residual cases, who could not benefit under this scheme for vocational training, those whose physical disabilities are such as preclude them from ever being able to re-enter normal industrial life. The Derwen Scheme has attempted to deal with this class by the foundation of a Settlement where such cases can remain living and working under sheltered circumstances.

It seems probable that post-war conditions will lead to a complete re-organization of our hospital system, when full consideration should be given to the question of rehabilita-

A complete scheme could be organized on the following lines:

Hospital to which the sick or injured is first admitted for the treatment necessary to arrest the disease, or to prevent as far as possible, permanent physical disabilities as a result of accident. The Out-patient Department under the control, if possible, of an expert in physical medicine who has at his disposal all those ancillary services including occupational therapy which may be considered necessary for the complete recovery of the patient. The Department should be closely linked with the local Labour Exchange, whose representative would be in a position to give guidance as to the best type of work for which a patient would be suited, in view of his possible residual disability. If the patient was not fit to re-enter his previous employment, he should be admitted from these departments to a Vocational Training Establishment.

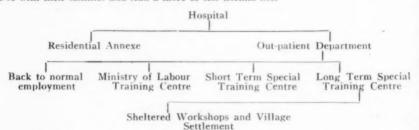
# Vocational Training Centres

These would be divided into three groups:
(1) The normal Ministry of Labour Training Centre.

(2) The Special Short-term Training Centre for those adults who have worked before, but who, because of their residual disability, need more specialized training than can be given in the Ministry of Labour centres.

(3) (a) The Special Long-term Training Centre mainly for adolescents who have never previously been in employment or those who because of their acute physical disability are never likely to be able to take up employment under normal conditions.

(b) Sheltered Workshops, where those last mentioned can be employed, and which would be associated with Village Settlements on the lines of Papworth, where they could live with their families and lead a more or less normal life.



This, admittedly, is an ideal scheme. It would involve radical amendment of the National Health Insurance Act, the Workmen's Compensation Act and the many other Acts concerned with the problem. Close liaison would be necessary between the various Government departments, the medical profession, the insurance companies, the employers, the trade unions and other bodies concerned, before the scheme could be even moderately

To a large extent its ultimate success would depend on the problem of unemployment being adequately handled in the post-war period. The phrase "fit for light work"

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which appears so often on medical certificates is unfortunate. Industry to-day has no room for the semi-fit. Their presence undoubtedly tends to slow down production and, if we are to compel employers to re-employ those injured in their factories and workshops, it seems essential that the injured should be returned in a fit condition to do a normal full day's work.

Miss E. M. Macdonald (Dorset House School of Occupational Therapy): Occupational therapy can be called the science of prescribed and supervised work and recreational activity, prescribed to hasten recovery from disease or injury. Occupational therapists work directly under medical supervision, and on prescription only—these being considered from four aspects: (a) The Physical; (b) the Psychological; (c) the Social; (d) the Economic. The prescriptions are divided into two categories: (1) Special Occupational Therapy;

(2) General Occupational Therapy

The special application is in direct relation to the injury or disability, whether it be physical or psychological. General Occupational Treatment is also of therapeutic value but concerns, not a particular seat of injury, but the patient as a whole person. This general occupational work is for the cases whose recovery is fairly certain, but whose attitude to the disability, and to the course of recovery, is uncertain, and whose general physical fitness is poor. There is yet another use for it: as will be mentioned later when describing some recent cases, the general occupational treatment, given perhaps on the wards to patients in bed, may be the introduction to future possibilities in the workshop and so make interest in recovery and transition to special treatment, more easily carried through.

It is difficult to give anything but approximate figures at this early stage in a new experiment, but it has been suggested that there are not more than 10% to 15% of specially remedial cases in a hospital such as the Fracture "A" or special hospital under the Emergency Medical Service Scheme: 50% to 60% of the cases may be on prescription for general occupational therapy. In passing it may be interesting to note as a parallel, from data collected in America in 1938, that in a mental hospital with an excellent organization for occupational therapy the figures given for Special and General pre-

scriptions correspond almost identically with these.

In the more particular application of the work to physical cases, occupational therapists are usually asked for treatment aimed at the restoration of function. Prescribing physicians and surgeons indicate that this is best achieved by the joint or muscle working with other joints and muscles in as normal a way as possible. Isolation of muscles is not encouraged unless essential. There is a need, therefore, for very careful choice of occupation and apparatus, and the working position of the patient, the particular stool or chair on which he will sit, as well as the work itself, must be considered. As essential as these points, are clear instructions to the occupational therapist, and ample time on the part of the latter to give supervision. Only if absolutely necessary are any artificial means of restriction or splinting used, and these for as brief a period as possible, their purpose being mainly to help the patient to think the right movement as well as to achieve it. To illustrate this point, there was one patient who had had a bad Colles's fracture. When given steady hammering to encourage flexion of this wrist, the patient worked merely by abducting and adducting his upper arm. For a brief period he was placed in a position with the forearm fixed and all movement had to be thought of and carried out at the wrist. The patient himself was impressed by the speed with which he overcame his efforts at compensatory movement and gained real benefit from the prescribed action.

In occupational therapy the psychological aspect of all cases comes under consideration. By this is not meant, however, any attempt on the part of the occupational therapist to treat the patient as a "mental case". Great emphasis is laid on the treatment of the case as a normal person—as a whole man. If, however, the patient is finding difficulty in adjusting to working conditions, a valuable contribution to the better and quicker recovery of the patient can be made by an occupational therapist, with a well-balanced outlook, based on a study of practical psychology as applied to patients, and with more time available for treatment than the medical officer in charge of the case.

This brings us to the social aspect. The interpretation of the term means the resocializing of the a-social, thus counteracting the effects of long hospitalization and perhaps boredom. The busy atmosphere in an occupational therapy department, the expectation and acceptance of work, the comradeship and triumph of achievement can, almost without the direct agency of the occupational therapist, bring surprising results. Recreation is widely used, sometimes under the direction of the occupational therapist, sometimes as successfully, or more so, in the hands of other experts. Economically, occupational therapy would not be completing its work unless it made its contribution towards putting the patient one step further on the road to security. There is

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some confusion as to where occupational therapy ends and vocational training begins.

The Ministry of Labour interim scheme for the training and rehabilitation of disabled persons offers valuable scope to occupational therapists for collaboration and experiment.

Occupational therapists are a part only of the rehabilitation team working under direction of a medical officer. It consists of nurses, physiotherapists, occupational therapists and physical training instructors. In addition there is the Almoner and, for cases with psychological disabilities, the Psychiatric Social Worker. On discharge from hospital the patient may return to his former employment, or to some non-hospitalized rehabilitation centre for the hardening-off process before return to employment. It may be that industries will become interested in establishing such Centres, as they and the Insurance firms have done so profitably in America, and that, in addition to this, they may employ a specialized occupational therapist in their own workshops who will, in collaboration with the authorities, plan graded work for the returning workman until he can tackle his own particular task with full strength. If unfit for return to employment, a patient may be discharged to a vocational training centre.

Below is an outline scheme suggesting a possible grading of patients for rehabilitation in hospital, and the type of occupational therapy for each grade:

### X. WARD CASES

A. Bed cases.—Given Special or General Occupational Therapy, e.g. Light Canework, Leatherwork, Weaving, Netting, Cord Knotting, Lettering, &c., or other suitable bed-work, such as making of requisites for hospital, &c.

B. Cases up for brief periods only.—Occupational therapy as above—or perhaps short visits to occupational therapy workshop for light work.

# Y. Ambulant Cases (Workshop and Gardens)

C. Those still on light work—with progressively extended work periods.—Light woodwork added to list of above occupations.

D. Stronger cases.—Doing some hospital duties, as general occupational therapy—and receiving other general or special occupational therapy in the workshop, probably doing woodwork, metal work or gardening.

E. Strongest cases.—Work as above, but for still longer periods and with greater resistance offered by graded tools and apparatus. Possibility of encouraging working speeds.

The minimum staff for the above would be a supervising occupational therapist, an assistant, a gardener-joiner, a part-time metal worker and voluntary helpers.

The training of an occupational therapist consists of medical (administrative and occupational) subjects, and the application of the latter to diseases and disabilities.

The qualifying examination is run by the Association of Occupational Therapists, the examiners being medical and occupational experts.

Two cases which received special treatment are quoted below:

# (1) Motor-cycle accident.

Fracture of right femur and patella; right radius and ulna; and third metacatpal. Left Bennett's fracture.

After five weeks he was put on occupational therapy, in bed.

Tried weaving flat rug on frame. General movements too tiring, (Thumb plaster renewed, operation on arm.)

Leatherwork (successful) but fingers weak. Sent to workshop—four weeks later—to mobilize right knee. Hard work not contra-indicated. Used adapted weaving loom—the beating being achieved by strong extension of knee. Lifting foot on to high pedal produced flexion of knee.

Fingers of right hand specially mobilized by arrangement of design, and shuttlework. Right arm now in plaster—with elbow hinge made, at surgeon's direction, in occupational therapy department—and fixed into plaster at each end.

Treatment continues.

### (2) Air-raid casualty.

Bilateral fractures of tibia and fibula. Lacerations and burns, legs, arms and hands. Occupational therapy prescribed. Knees and ankles stiff. Left leg in plaster. Right leg not weight bearing. Work given was turning of potters wheel, rhythmically, in small range (providing foot power for another patient to work), and wedging clay with hands. Patient was transferred to light loom worked by roller skates on wooden track; sitting on special stool with flap support for knees.

track: sitting on special stool with flap support for knees.

Strength of resistance increased—work excellent. Patient showed considerable improvement on discharge.

[The views expressed in these papers are not necessarily the views of the Ministry of Health, but are a purely personal expression of opinion.]

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# Section of Anæsthetics

President-A. D. Marston, D.A.

[March 6, 1942]

# Trichlorethylene as a General Analgesic and Anæsthetic

By C. LANGTON HEWER, M.B., B.S., D.A.

About two years ago, I was asked by Dr. Charles Hadfield, secretary to the combined Anasthetics Committee of this Section and of the Medical Research Council, to investigate the possibilities of trichlorethylene as a general anasthetic.

In June 1941 I made an interim report in the form of a short article in the *British Medical Journal*. The results obtained were so encouraging in certain directions that since that date I have continued to use the drug, and I now hope to put before you the conclusions I have reached.

Physical properties.—Trichlorethylene was first described in 1864; its chemical formula is CCl<sub>2</sub>:CHCl. It is a heavy colourless liquid with a specific gravity of 1·47 at i5° C. and a boiling point of 87° C. The odour resembles that of chloroform without its pungency. In view of the similarity of the two fluids in respect of both weight and smell, I have suggested to the manufacturers that trichlorethylene prepared for anæsthesia should be coloured either blue or green. This would readily distinguish it from chloroform which is either colourless or tinted red by one maker.

Trichlorethylene is not inflammable in any circumstances nor will its vapour explode when mixed in any proportion with air, oxygen or nitrous oxide.

The pure drug tends to decompose in strong sunlight with acid formation, and should therefore be stored in stoppered amber bottles. The addition of 0·01% thymol retards decomposition, and this has been done in the case of the product known as "trilene". As an extra precaution, the manufacturers suggest that it should not be used for inhalation purposes after twelve months from the date of bottling.

The cost of purified trichlorethylene is very reasonable as if supplied in lots of 8 lb. to hospitals the price is 3s. 6d, per lb. It has been estimated that the average cost per administration works out at about 4½d.

Commercial uses.—Trichlorethylene is chiefly used for the dry-cleaning of clothes, the de-greasing of metals and the de-waxing of lubricating oils. For these purposes, the fluid is sold under a variety of trade names such as chlorylene, gemalgene, trethylene and triklone. These preparations may contain a variety of impurities and should not be used as anæsthetics.

It is of some interest to know that addiction to trichlorethylene is not very uncommon amongst industrial workers. The vapour used for de-greasing metals rises in a vat and is condensed by cold pipes. Some workmen find considerable pleasure in leaning over the sides of the vats and inhaling the vapour until they feel intoxicated.

MAY-ANESTH, 1

Industrial poisoning.—On the Continent several writers have recorded cases of industrial poisoning in factory workers when crude trichlorethylene was used. Symptoms such as giddiness, vomiting, optic neuritis and various palsies have been described (Plessner, 1916; Gerbis, 1928). Some cases have proved fatal (Stüber, 1931). It should be noted that all these patients had been exposed to the vapour of commercial trichlorethylene which, as already mentioned, may contain a great variety of impurities. Workers constantly exposed to trichlorethylene vapour in aeroplane works are said to be liable to dermatitis (Schwartze and Russell, 1941).

External application.—A few years ago, the use of trichlorethylene was recommended as a skin purifier and to clean up burns and dirty wounds (Trumper and others, 1936). For these purposes Imperial Chemical Industries Ltd. produced a specially purified and stabilized liquid under the name "trilene". With the exception of some pure trichlorethylene made and generously supplied by Mr. C. Chalmers who originally suggested the investigation, all cases have had trilene for inhalation.

Therapeutic inhalation.—The drug has been used for some time to relieve the pain of trigeminal neuralgia. For this purpose, the vapour is inhaled from broken capsules as in the case of amyl nitrite. The origin of this procedure is worth noting. Two separate observers reported that patients suffering from chronic trichlorethylene poisoning showed complete bilateral paralysis of all divisions of the trigeminal nerve (Plessner, 1916; Gerbis, 1928). It was supposed that the drug had a specific action on this nerve and its administration for the relief of trigeminal neuralgia was suggested (Oljenick, 1928) and shown to be effective (Glaser, 1931). It appears to me quite certain that the relief from pain is not due to any effect on the trigeminal nerve but to the state of general analgesia which is induced and to which I will refer later. This seems to be an example of faulty reasoning leading to the desired result.

Experimental work on animals.—During the past twenty-one years several workers have fully investigated the effects of trichlorethylene on animals.

In 1921 Joachimoglu found that the pure vapour was not irritating to the respiratory tract and that inhalation was not followed by hæmolysis or by fatty degeneration of the liver.

In 1934 Herzberg reported that specimens of spleen, liver, kidney, pancreas, adrenal, diaphragm, heart, lung and pectoral muscle taken from three dogs killed by overdosage of trichlorethylene after having been deeply anæsthetized for periods of two and a half to three and a half hours showed no gross or microscopic pathological changes.

In 1935 Krantz and others anæsthetized the same rats repeatedly (up to 30 times) with trichlorethylene. The animals were then killed and the various organs examined. Although some pathological changes were found, they were in the main slight and inconclusive. In rabbits slight hyperglycæmia was noted. The same workers found that anæsthesia could not be obtained by the rectal administration of the drug and that nerve conduction was not affected by the local application of trichlorethylene.

In 1939 Lande and others anæsthetized guinea-pigs, rats and mice with trichlorethylene daily for two and a half months, the duration of narcosis being from fifteen minutes to one and a quarter hours per day. After death it was hardly surprising that some inflammatory changes in the liver and kidneys were noted.

From these extremely severe tests it may reasonably be concluded that in the usual experimental animals, trichlorethylene is only slightly toxic—certainly much less so than chloroform.

Previous work in human anæsthesia.—The only published work which can be traced is that on a series of 300 patients anæsthetized with trichlorethylene by Striker and others in America in 1935. These were all short administrations for minor operations, and in some instances analgesia only was produced. Eight of these patients became violent in the second stage, and the third stage of anæsthesia could not be reached. One patient stopped breathing from an overdose but recovered after artificial respiration. After-effects were slight, and on the whole the drug was regarded as a satisfactory anæsthetic.

In the following year (1936) the Council of Pharmacy and Chemistry of the American Medical Association considered the evidence for the usefulness of trichlorethylene and concluded that "the case had not been completely made out".

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Details of present investigation.—The observations which follow are based upon about 400 administrations. Most of the commoner major and minor operations were performed under trichlorethylene anæsthesia or analgesia, their duration varying from five minutes to five hours and forty minutes: the latter operation being the removal of a cerebral tumour from a woman with bronchicetasis. The administration in this case was by my colleague Dr. B. Rait-Smith and I am glad to say that the patient survived. The patients' ages were between 14 months and 81 years and included Service casualties, air-raid casualties and ordinary hospital civilian patients.

# Methods of Administration

It at once became evident that an open mask administration was impracticable owing to the low volatility of trichlorethylene. In America a special apparatus has been devised to vaporize the drug incorporating an air compressor driven by an electro-motor (Jackson, 1934). As we had neither the wish nor the facilities to develop complicated machinery, we began by putting trichlorethylene in the chloroform bottle of a continuous-flow apparatus and using it as an adjuvant to nitrous oxide and oxygen. When used with partial rebreathing this method was quite satisfactory. In most cases a face-piece was employed, but, when indicated, a nasal or oral endotracheal tube was passed. Muscular relaxation was usually ample for intubation to be performed without difficulty.

If the CO<sub>2</sub> absorption technique is used, it is essential to have the vaporizer in the patient's respiratory circuit. Insufficient concentration of trichlorethylene is obtained if the basal oxygen feed alone is used to vaporize the drug as in the single-phase Waters' system or in the standard two-phase apparatus as supplied to the E.M.S.

After a fairly full investigation of trichlorethylene as an adjuvant to nitrous oxide and oxygen, it was decided to find out whether the drug had any possibilities when given alone. After various trials and errors, a simple draw-over apparatus was adapted from a Walton ether bottle. In order to produce analgesia only, a small bottle without a rebreathing bag is sufficient, but to ensure that the third stage of anæsthesia is reached, a large bottle containing a wick is necessary and some rebreathing is desirable. By plugging in a similar ether bottle in series a compact apparatus results which is adaptable to practically any type of inhalation analgesia or anæsthesia including endotracheal work. In the latter case it is, of course, essential to have an air-tight fit, either by plugging or by the use of a ballooned tube. Dr. H. R. Marrett, Senior Resident Anæsthetist at Hill End Emergency Hospital is largely responsible for the design of this apparatus which (with one bottle) can be produced to sell retail at about £5 l0s.

When used continuously for general anæsthesia, about 13 c.c. of trichlorethylene per hour are consumed.

### Stages and Signs of Analgesia and Anæsthesia

In most respects trichlorethylene resembles chloroform rather than ether.

During the first stage, some degree of general analgesia always seems to be present. This comes on after a few breaths and varies in degree from some numbness to pain in resistant patients to that of absolute analgesia during which can be carried out such procedures as wedging plasters, insertion of bone pins, cystoscopies, painful dressings, &c. The sensation of general analgesia is one of curious detachment. One patient rather aptly described it by saying that he appeared to be watching himself being operated upon as if he was a disinterested third party. Two patients suffering from trigeminal neuralgia were given trichlorethylene and the pain was practically abolished in both cases, but at the same time sensitivity to pain was greatly diminished in all areas. I am convinced that the relief in this condition is due to general analgesia and not to any specific effect upon the trigeminal nerve, in spite of the statement made in the book just published by no less a pharmacological authority than Adriani. Trichlorethylene exerts the most potent and rapid analgesia of all the volatile drugs with which I am familiar, including nitrous oxide, and it appears to me that it might be of very great use, especially under war conditions where the absence of heavy and complicated apparatus, and hot water jackets, gas cylinders and inflammable vapours are all desirable.

The second stage of anæsthesia is not usually marked but occasionally violent excitement

The third stage is characterized by quiet automatic respiration and a pupil which is usually small. The eye reflexes are similar to those obtaining with chloroform.

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# Effects on Respiratory System

The odour of trichiorethylene is not pungent nor does its vapour appear to have any irritant effect upon the respiratory passages. It follows that the vapour concentration can be increased rapidly leading to a short induction of anæsthesia. No excessive salivation or secretion of mucus was noticed even if premedication had been inadequate or badly timed. Several major thoracotomies were done under trichlorethylene anæsthesia as were many other operations upon patients suffering from bronchitis, bronchiectasis and active phthisis. In no case could any exacerbation of the pulmonary disease be attributed to the anæsthetic. The depth of respiration was not appreciably altered but in about 30% of patients receiving the drug as an adjuvant to nitrous oxide and oxygen, some increase in the rate occurred. This usually subsided after fifteen to twenty minutes but in a few cases it persisted. When present, this rapid breathing is a definite disadvantage in thoracic surgery. The tendency was not so marked when trichlorethyleneair was used. On one occasion an overdose was inadvertently given. Respiratory arrest occurred, but no difficulty was encountered in restoring natural breathing. The pulse remained steady throughout.

# Effects on Cardiovascular System

The blood-pressures usually remained within normal limits except for some rise when the second stage of anæsthesia was marked by much excitement. Dilatation of the vessels in the skin and subcutaneous tissues such as occurs with ether and cyclopropane was not seen, and surgeons frequently commented upon the absence of capillary oozing. This was particularly noticeable in nasal and in ophthalmic surgery. The pulse-rate was generally raised slightly as in the case of most inhalation anæsthetics.

Particular attention was paid to the cardiac rhythm as trichlorethylene contains three chlorine atoms in its molecule, and at least two other compounds with this characteristic (chloroform and trichlorethanol) can cause grave cardiac irregularities and even primary cardiac failure (Wood, 1938; Hewer and Belfrage, 1938). Clinically few cardiac irregularities could be detected apart from sinus arrhythmia in young patients which disappeared when full anæsthesia was reached. An irregular pulse was definitely less common than with cyclopropane, and several patients with extrasystoles before operation showed a regular rhythm after anæsthesia had been induced with trichlorethylene. This is, of course, common with inhalation anæsthesia generally. Two cases of partial thyroidectomy had auricular fibrillation which remained unchanged throughout the anæsthesia.

The possibility of primary cardiac failure still cannot be entirely excluded, but so far I have not heard of such an event although a large number of administrations have now been made. Since the publication of my original paper, 48 hospitals have been using trichlorethylene and it has been estimated that at least 10,000 patients have been anæsthetized with it.

Dr. K. D. Keele kindly arranged for electrocardiograms to be taken during the induction of anæsthesia in 33 cases. A Cossor-Robertson cardiograph and later a Cambridge instrument were installed in one of the anæsthetic rooms, and direct visual observations as well as photographic records were made before and during induction. In most of the cases so observed there was no alteration in the tracing apart from a slight decrease in the sinus tachycardia as the third stage of anæsthesia was reached. In one instance regular auricular extrasystoles alternating with normal systoles occurred over a period of some three minutes and then ceased. In two other cases occasional ventricular systoles were seen during the second stage, but disappeared as the third stage was reached. In no case were multiple ventricular extrasystoles seen. These were particularly looked for in view of their comparatively frequent occurrence during chloroform anæsthesia. This limited number of observations suggests that there is no evidence of any particular cardiac danger with trichlorethylene.

Muscular relaxation.—The degree of muscular relaxation obtainable with trichlorethylene is variable. As a general rule, operations upon the head, neck, thorax and
limbs present no difficulty, but adequate relaxation for major abdominal surgery is not
always readily available. It is possible that a really deep plane of narcosis may produce
the desired result, but I have always played for safety and changed over to ether in
preference to pushing trichlorethylene. One opportunity occurred for observing the effect
of the drug upon the uterine musculature. An abdominal hysterotomy was performed

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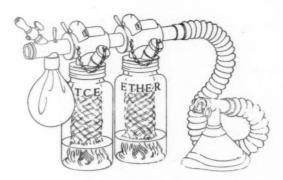
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to terminate pregnancy on account of active phthisis. The surgeon remarked upon the exceptionally good retraction of the uterus following extraction of the fœtus. After an average of twenty minutes' administration, it was found that the vapour concentration of trichlorethylene could be greatly reduced without prejudice to muscular relaxation.

Effects on sugar metabolism.—I)r. A. Jordan kindly made blood-sugar estimations before, during and after anæsthesia with trichlorethylene. In no case was there much disturbance, and taking an average, it could be said that there was no significant change. This contrasts with the rise constantly seen with chloroform and ether (Hewer, 1939).

One diabetic patient was included in the series. An abdominal operation lasting one hour fifteen minutes was performed under nitrous oxide - oxygen - trichlorethylene anæsthesia. The sugar tolerance was tested one week after operation and was found to be unchanged.

Effects on blood urea.—Blood-urea estimations were made by Dr. Jordan before, during and after anæsthesia. The changes were so slight as to be within the range of experimental error. Here again the contrast with chloroform and ether is marked.



"Draw-over" inhaler for producing either analgesia or anæsthesia with trichlorethylene and/or ether. It is suggested that this might prove useful both in civil practice and under Service conditions.

(Block kindly lent by Messrs. A. Charles King, Ltd.)

# After-effects

If analgesia only has been produced, it is unusual for any after-effects to occur. Occasionally slight dizziness or headache may be present for a short time.

Of the first 127 patients anæsthetized for a great variety of operations, 61% had no nausea or vomiting, 26% had nausea or slight vomiting and 13% moderate or severe vomiting: 5% complained of headache. Those who had had previous experiences with ether nearly always commented favourably upon the absence of an unpleasant taste and smell.

In most cases the urine was tested as a routine on the day after operation. In one instance only was the presence of albumin found and acctone was always absent. This is in marked contrast with other anæsthetics. For example, albuminuria has been found almost constantly after the prolonged administration of ether and in about 20% of patients anæsthetized with chloroform (Stephen, 1929). Again, acctonuria has been demonstrated in 67% of patients operated upon under all forms of general anæsthesia and in 85% under local analgesia (Schulze, 1924). No pulmonary complications were observed, and, as already mentioned, existing lesions did not appear to be affected.

# Summary and Conclusions

So far as our present knowledge goes, trichlorethylene when inhaled resembles chloroform in its effects but is less potent as an anæsthetic, more potent as an analgesic and less toxic.

The advantages of the drug are: (1) The absence of irritation to the respiratory passages; (2) the comparative absence of superficial oozing from cut tissues in patients under its influence; (3) the high degree of analgesia available; (4) the non-inflammability of its vapour; (5) its relative cheapness and availability and the fact that no complicated apparatus is necessary.

The disadvantages are: (1) Complete muscular relaxation is sometimes difficult to achieve; (2) the respiratory rate is sometimes raised.

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# Section of Comparative Medicine

President-G. DUNLOP-MARTIN, M.R.C.V.S.

[December 17, 1941]

# DISCUSSION ON THE CONTROL OF DISEASES OF CATTLE INIMICAL TO MAN

# TUBERCULOSIS

[For first Discussion see Proceedings, December, 35, 115 (Sect. Comp. Med., 1-8)]

Professor T. Dalling: Infection of cattle with the bovine type of tubercle bacillus is of major importance from the economic and public health points of view. We should consider the control of bovine tuberculosis as it concerns the health of mankind and from the standpoint of the loss it occasions to the agricultural community, and to the country. It was stated in the Report by the Committee of the Economic Advisory Council on Cattle Diseases:

"That about 40% of the cows are infected to a varying extent with bovine tuberculosis."

"That on account of tuberculosis the annual loss due to the necessity of maintaining herds at full strength and to meat condemned was about £3,000,000 per annum, without taking account of the loss in productivity during life."

There are three main methods of controlling tuberculosis in cattle: (1) The rendering harmless of the edible products from infected cattle, (2) the eradication of the infection from the living animal and (3) the creating of a resistance or immunity to the infection. Each of these methods has its place and in some measure they may be complementary one to another

(1) The common methods of transmission of tuberculous infection from animals to the human subject is by the consumption of infected milk and, to a less extent meat. A satisfactory method of pasteurization, carefully carried out, would go far to allay the danger from infected milk and although pasteurization might control tuberculosis from animals to human beings or to calves and pigs, there still remains the problem of the transmission of the disease from animal to animal.

(2) The eradication of tuberculosis from a herd or group of animals and the prevention of further infection is the ideal method of control. It involves the recognition of infected animals, their removal from the group, periodic examination of the supposedly "clean" animals and guarding them against any subsequent infection.

The recognition of the infected animal varies from periodic clinical examinations to the application of the tuberculin test. Periodic clinical examinations are of limited value for diagnosis can be made only when an animal is palpably infected and by that time the casual organisms are being eliminated and probably have been eliminated for some time. It may also be necessary to resort to biological testing of milk or excretions before a definite diagnosis can be made: this detracts from the value of such a method of control.

The tuberculin test is the most satisfactory method in practice to-day. It is by no means perfect and difficulties have arisen concerning types of tuberculin and the interpretation of reactions. The older subcutaneous test has given place to the intradermal method of testing and the old crude tuberculin, as prepared originally by Koch, has passed through several stages of evolution till to-day we have at our command the highly purified protein derivative (P.P.D.). As more satisfactory types of tuberculin have been evolved so the nature of positive and negative reactions in cattle has altered.

The tuberculin test is, in reality, a means of measuring the allergy of an animal and not of estimating the degree of infection or the state of the tuberculous lesions. There is some evidence that recently infested animals react "strongly" to tuberculin but there is still little information concerning the exact extent of lesions and their state of activity associated with a positive tuberculin reaction and the nature of that positive reaction. It follows, therefore, that in using the tuberculin test in controlling tuberculosis of cattle many animals which at the time of testing were not excreting bovine tubercle bacilli are classified as reactors and are treated as infective animals. This may seem a wastage but the risk of such animals becoming active spreaders of infection is always present.

Another point is the reaction to tuberculin of animals infected with acid-fast bacilli

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other than bovine tubercle bacilli, the most important of which is the avian tubercle bacillus. While it has been recognized for some years that cattle become infected with this organism and develop an allergy to mammalian tuberculin, it is only within fairly recent times that the incidence of the infection has been realized. It has been shown conclusively that mammalian tuberculins of high potency demonstrate the allergy to avian tuberculous infection and so important has this state of affairs become that it has been necessary, in a number of herds, to use the specific avian tuberculin in differentiating bovine and avian tuberculous infections in cattle. Infection with avian tubercle bacilli has complicated the story of tuberculin testing. It is necessary in searching for the most satisfactory tuberculin to consider the potency and dose which will detect the largest number of animals infected with bovine tubercle bacilli and the least number infected with other organisms which give rise to an allergy detected by mammalian tuberculin.

A matter of much importance is the disposal of infected cattle. The regulations in this country provide for the slaughter of "open" cases of tuberculosis but no provision is yet made for the disposal of cattle which react to the tuberculin test. The result is that in clearing a herd from tuberculous infection by the use of the tuberculin test many infected animals may find their way to the open markets and in their turn may create new sources of infection or may perpetuate infections in herds throughout the country.

(3) The creating of resistance or immunity to tuberculosis in cattle has been the subject of study and many products have been used, varying from tuberculin to dead and living organisms. The use of each product has been followed by favourable reports, but few have stood up to carefully controlled experimentation. A brief reference will be made to B.C.G. and the vole acid-fast organism.

B.C.G. was originally a virulent strain of bovine tubercle bacillus which, by repeated subcultivation on a suitable medium was rendered innocuous to cattle though it still retained antigenic properties. The recorded results with B.C.G. vary considerably, but there is much evidence to support the original findings that, used in the manner prescribed, injections of this strain set up a high degree of resistance to infection with bovine tubercle bacilli. The experiments carried out in this country, notably those by Buxton, Glover and the late Stanley Griffith, demonstrate that B.C.G. is of considerable value for controlling bovine tuberculosis in cattle. The method devised by these workers is to create a resistance in the young, healthy bovine by the injection of B.C.G. and to reinforce the resistance by further injections at intervals. It is essential that the animals are free from infection at the time of the first injection and that they are protected from infection till the necessary degree of resistance has been established. The subsequent behaviour of the "protected" animals appears to be dependent largely on the degree of infection to which they are exposed. It is apparent that in spite of exposure to heavy infection the protected animals either resist the infection or become infected only to a mild degree, the lesions being much less marked, in general, than those of control, unprotected animals. More recent results of field experiments indicate that animals treated regularly with B.C.G. resist in a marked degree infection in herds in which "open" cases of tuberculosis are present. The results seem to be sufficiently encouraging to merit an extensive field trial in suitable herds. It must not be assumed, of course, that our knowledge of the use of B.C.G. is complete. Much information, now lacking, would be obtained from such a field trial.

Within quite recent times an addition has been made to the group of acid-fast organisms by the isolation by Wells from the vole of an organism with many features common to tubercle bacilli. This organism has been used in experiments for the creating of a resistance to infection with bovine tubercle bacilli. The conclusions of Wells and Brooke are that the vole bacillus "gives a degree of protection which apparently is far greater than has been recorded by other means". We have also worked with Wells' organism at Cambridge and in an article published by the late Stanley Griffith and myself, we recorded the results of its injection into guinea-pigs and calves. Although the number of calves used in the experiments was small we came to the conclusion that "the results obtained in calves with the vole strain of acid-fast bacillus were unexpectedly good and better than those which followed the use of B.C.G. as a vaccine". Griffith and I expressed the opinion that the immunizing power of the strain should be further tested in calves: work is now in progress at Cambridge and although the experiments have not progressed very far it is evident that the former results are being borne out. still much to be done concerning the use of the vole strain before we are ready for a large field trial. Such points as the duration of resistance to bovine tuberculosis following the use of a single dose of the organism and the degree of resistance set up must be the subject of further work. It would seem, however, that in the vole organism we have a product which might be found of value in the control of bovine tuberculosis.

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A disadvantage of both B.C.G. and the vole organism is that their injection is followed by an allergy to mammalian tuberculin. There is some evidence that the allergy fades in time and though the use of these products may complicate eradication schemes in some measure, further work on the subject will show in how far the two methods of control (climination of "reactors" and the creating of resistant animals) can be carried out at the same time.

#### THE PREVALENCE OF HUMAN TUBERCULOSIS OF BOVINE ORIGIN

Dr. S. Roodhouse Gloyne: Bacteriological statistics.—There is no reliable clinical test for differentiating between human and bovine type infections in man, whilst the belief that tuberculins prepared from the two strains do not produce diagnostically different skin reactions has been held fairly generally for many years. Calmette was very dogmatic that there was no difference whatever, and the question seems to be regarded as closed—perhaps a little prematurely. The detection of the bovine type has therefore to be arrived at by relatively slow and laborious bacteriological investigations which are usually considered to be of secondary importance in routine clinical pathology, and are, consequently, more often than not, omitted. If we had some quick and reliable method of demonstrating bovine infection, we could more readily bring the lesson home to everybody concerned. There is, however, no lack of statistical material on this aspect of the subject. The bacteriological investigations show that there is a higher percentage of bovine type infections in Scotland than in England. In 1937 Griffith summarized his findings which are shown in the rearranged table:

8	Pe		of cases bovine bacillus	infected type of		Pe	rcentage th the	of cases bovine bacillus	infected type of
Variety of tuberculosis	Number of cases		5-15 years	All	Variety of tuberculosis	Number of cases	Under 5 years	5-15 years	All
	ENGL	AND				SCOTI	LAND		
Cervical gland Lupus Scrofulodermia Meningeal Bone and joint Genito-uringry	126 191 60 265 553 23	90°9 58°4 53°3 28°1 29°5	53°4 44°4 43°3 24°5 19°1	50°0 48°7 36°6 24°6 19°5	Lupus Cervical gland Genito-urinary Bone and joint Meningeal	13 93 42 218 203	100°0 65°0 46°2 34°4	71'4 62'3 28'9 14'0	69°2 51°6 31°0 29°8 29°6

One of the most extensive Scottish investigations is that of Blacklock, carried out on tuberculous children in Glasgow and the West of Scotland. Of 241 strains isolated, 152 were of the human and 89 of the bovine type. Pulmonary tuberculosis is not included in Griffith's table because up to 1922 only four cases of bovine bacillus infection in phthisis had been reported and the condition was regarded as a bacteriological curiosity. About this time Munro and others discovered more cases in Scotland, and further investigation was stimulated, with the result that Griffith was able to report fifteen years later, no less than 163 instances in England and Scotland, and the number is still increasing.

Summarizing the figures, it may be stated that in England, taking all ages into consideration, about half the cases of cervical gland tuberculosis and lupus, about one-quarter of the meningeal, and rather more than one-sixth of the bone and joint and genitourinary cases are due to the bovine bacillus. In practically all instances the figures for Scotland are higher. In pulmonary tuberculosis, this difference is especially marked. Griffith's last figures were 1% for Wales, 1.6% for England, and 7% for Scotland. Lastly, there is evidence to suggest that bovine type infections vary even in different parts of Scotland and that they are higher in the North of England than in the South.

#### Calculations from the Registrar-General's Statistics

Sir William Savage has estimated that 1% of respiratory and 23% of non-respiratory tuberculosis, or 5.5% of the total deaths from all forms of the disease at all ages are due to the bovine type of bacillus. Applying these factors to the Registrar-General's statistics he has estimated that in the year 1927 there were 310 deaths from respiratory and 1,635 from non-respiratory forms of tuberculosis, making the calculated total deaths from tuberculosis of bovine origin to be 1,945. If Savage's method of calculation is applied to the Registrar-General's figures for the last year's statistics available, viz. 1938, we obtain the following:

21,930 respiratory disease deaths 4,246 non-respiratory disease deaths = 219 calculated deaths due to bovine bacillus = 26,176 total deaths = = 1,195 calculated total deaths due to bovine bacillus

Cobbett writing during the last war calculated from the Registrar-General's statistics that 33% of the mortality from all forms of tuberculosis in children under 5 could be attributed to the bovine type.

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These figures based on Registrar-General's Reports take no account of the non-fatal cases. Stanley Griffith in one of his last papers stated that he regarded the bovine strain as at least as virulent as the human. If the calculations are based upon notifications instead of upon death statistics, the resulting figures for 1938 are:

37.879 respiratory disease notifications = 378 calculated notifications due to bovine bacillus 12.810 non-respiratory disease notifications = 1.946 calculated notifications due to bovine bacillus

50,680 total notifications = 2,324 calculated total notifications due to bovine bacillus

#### Milk Sampling

The source of the bovine bacillus.—When Delepine began his pioneer work in Manchester, the percentage of positive milk samples was 17.2. That was in 1897. In his last year, 1907, the percentage had fallen to 5.9. In 1931 a Ministry of Health Memorandum gave percentage figures for 1922-27 for certain selected areas as ranging from 5 to 9.8. The results obtained in the laboratories of the London Chest Hospital are mostly from mixed samples collected in the Home Counties. Records of 1,560 samples examined during the years 1928-1931 yielded 9.1% of positives. Thereafter the figures improved, and during the period 1935-1939 the positives fell to 6.2%. Although our more recent records have been destroyed by enemy action, I have reason to believe that the percentage of positives had declined still further to about 4 at the outbreak of war. There was, however, a disturbing increase in our figures during 1940.

#### Special Categories of Milk

In dealing with special designations of milk the emphasis must be laid on the tuberculin test. Even with regularly conducted tuberculin tests in a dairy herd, positive milk samples are occasionally encountered, due presumably to infection arising between one test and the next. These positives probably number, however, less than 1%. Clinical examination of the udder unsupported by a tuberculin test does not in my experience of milk testing greatly reduce the percentage of positive samples, whilst in the case of pasteurized milk everything depends on the efficiency of the plant. An investigation in Scotland recorded in 1933 showed that the percentage of positive milk samples after the holding method of pasteurization varied from 4.9 in Dundee to 1 in Edinburgh with an average for the four large cities of Edinburgh, Dundee, Glasgow and Aberdeen, of 2.8%. (The figure for the raw bulked milks assembled in the containers averaging 600 gallons, was 37.5%.) Tests at the London Chest Hospital yielded 2.5% of positives in 276 samples. I presume none of us will be satisfied with these figures, and personally I am convinced that if pasteurization is to be generally adopted in this country, certain safeguards must be adopted: (I) The operation must be carried out at well organized central depots by experienced persons. (2) Only pasteurizing plants which have been tested and passed by the public health authorities should be used. (3) Bacteriological samples before and after pasteurization must be taken regularly in just the same way that bacteriological samples are taken of a well regulated water supply. (4) Regular inspection for the detection of technical engineering defects is needed.

#### Milk Products

The commercial products which are likely to contain bacilli are raw cream, dried and condensed milk, butter and cheese. When a milk sample containing tubercle bacilli is centrifuged, the organisms may be found in the cream layer as well as in the deposit. It is therefore reasonable to assume that raw cream separated from a bulked milk sample has about as good a chance of containing tubercle bacilli as the milk from which it is separated, but relatively few investigations have been made as compared with milk and in actual practice the amount of raw cream consumed is not great. Clotted cream and cream from pasteurized milk being heated come into quite a different category, whilst dried and condensed milk undergo special treatment which ought to destroy tubercle bacilli. Some years ago, I made an investigation of 30 different brands of condensed milk, machine skimmed and full cream, English and foreign purchased in small grocers' shops in the London area. Most of them showed recognizable cells in the centrifuged deposit, and one contained a few acid-fast bacilli, probably phagocyted, but all the brands were negative to the guinea-pig test. There are only a few recorded series of tests with butter and cheese and the numbers are so small that they are not statistically significant. In peace-time about half our butter supply and a considerable amount of our cheese are imported from countries where bovine tuberculosis is not common, and pasteurization almost the rule. It is probably safe to assume for practical purposes, therefore, that, as Savage has remarked, the majority of the examples of human tuberculosis of bovine origin can be credited to the consumption of liquid milk containing living tubercle

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bacilli, and I should doubt if the exigencies of the war are likely to alter this general statement. Liquid milk must always be the first object of our bacteriological control.

#### The Infecting Dose

Practically nothing is known as to the minimum dose of tuberculous milk which is necessary to cause infection in man, and not a great deal as to the dose in the guinea-

In children, it is generally believed that the tubercle bacilli can pass through the intact mucosa of the intestine, but whilst this is so, there is evidence both in infants and in calves that primary lung infection can take place by the regurgitation of milk from the cesophagus. In the Lubeck disaster 251 infants were given by mouth B.C.G. vaccine to which a virulent human strain of tubercle bacillus had accidentally gained access in the laboratory. Of these children, 77 developed tuberculosis from 2 to 498 days afterwards. Naturally the majority had primary abdominal lesions, but a significant number had primary lung lesions.

In the guinea-pig I have, on two separate occasions, obtained positive results with the subcutaneous inoculation of I c.c. of uncentrifuged milk from a bulked sample from five

This subject of dosage is therefore of more than academic interest. In man, it would throw light on the whole question of human tuberculosis of bovine origin to know how many of the healed mesenteric gland lesions met with post mortem, are due to bovine infection but unfortunately there are experimental difficulties in determining the answer. In the guinea-pig the variation in dose—and consequently in the length of time taken to develop tuberculosis—leads not only to delay in reporting samples, but to variations in the percentage of positives. It has been claimed, for example, that the percentage of positives can be increased by as much as 50%, by using two animals for each test, and allowing one of them to survive for eight weeks. It is false economy to be so parsimonious in our tests where so much is at stake.

#### CATTLE CONTACTS AND CARRIERS

This brief survey cannot be closed without some mention of the relationship which at first sight seems so anomalous. The investigations of Griffith, Munro and Cumming have brought new facts on the relationship between chronic pulmonary tuberculosis and bovine infection. A steadily increasing number of cases is being recorded in which the bovine bacillus has been recovered from the sputum of farm workers suffering from One of the interesting side-lights on the subject is the association of cervical gland tuberculosis with the pulmonary lesion, an association which is so rare in the case of human type infection, that a previous generation of physicians taught that cervical gland disease protected against phthisis. Finally, strains of tubercle bacilli are sometimes obtained from milk samples which are of low virulence for the guinea-pig. It should be borne in mind that avian strains of the tubercle bacillus are occasionally met with in cattle, and a few such have been obtained by cultivation experiments with milk samples. Apart from these contingencies, we have to remember that bovine strains are not always of full virulence. In Canada, Watson has noted what he calls a carrier state in cows, in which he believes tubercle bacilli may live at the expense of the host without causing He has further shown that these carriers may lose resistmaterial damage or disease. ance and sooner or later, when physical and chemical factors and changing environment give favourable opportunities, develop typical tuberculosis.

#### DISCUSSION

(1) It is estimated that 1% of deaths from respiratory, and 23% from non-respiratory tuberculosis at all ages are due to the bovine bacillus; whilst some 33% of children under 5 who die of tuberculosis in this country are victims of this type. Recent investigations have suggested that the estimate of 1% for the respiratory form of the disease errs on the conservative side. It is as high as 7% in some parts of Scotland. In 1932 Fishberg wrote that he believed tuberculosis of bovine origin to be proportionately "more common in the British Isles than in any country in the world".

(2) If we could assume that the ratio between human and bovine type infections remains at a constant figure, we should be entitled to assume also that tuberculosis due to the bovine type is sharing in the general decline in the tuberculosis death-rate. Unfortunately there is not sufficient bacteriological control of cases in each decade to be quite sure that this is so, though the improvement in milk sampling before the war points in this direction.

(3) There are as yet no extensive data available for the war period. There has been a rise in the deaths from tuberculosis in females of the age-groups 15-25 from 1,761 in

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1938 to 2,073 in 1940, but I do not know how much of this rise, if any, is due to non-pulmonary tuberculosis which contains as we have seen, the largest proportion of bovine type infections. In Wales and Monmouth there has been a rise from 110 to 149 in the death-rate per million population. This rise—the first time since 1915 that the mortality rate of any year has been so definitely in excess of that of its predecessor—is mainly due to a disturbing increase in the number of deaths from tuberculous meningitis. Whether we can attribute the usual quota of one-quarter to bovine infections I do not know.

(4) Although pasteurization is valuable in reducing the amount of infection spread by milk, it cannot be regarded as a solution of our problem, and does not eradicate tuberculosis in cattle. It is not sufficiently recognized that pasteurization is a technical operation requiring careful routine bacteriological control and that without that control a false sense of security may be encouraged. We need more bacteriological records of our pasteurizing plants. The flash process may be used in war-time.

(5) Bacteriological statistics from various parts of the country indicate that the bovine infections are unevenly distributed. The percentage is highest in Scotland and lowest in the South of England, the North of England occupying an intermediate position. There are quite local differences also.

(6) Years ago, Delepine found that these local differences existed also between the farms of various areas sending milk into Manchester. Similar variations have been noted by numerous observers throughout the country since then. There appear to be areas where bovine tuberculosis is endemic.

(7) More investigations are needed to correlate the prevalence of tuberculosis in man and in dairy cattle in the same area, or in the areas from which the milk supply is drawn.

(8) Little is known about dosage, but it has been shown that 1 c.c. of tuberculous milk will infect a guinea-pig. The excretion of bacilli in the milk probably varies from day to day.

(9) Although primary infection with the bovine strain occurs most frequently by the intestinal tract, in infants and young children it may take place by the respiratory route by regurgitation from the œsophagus. This has been shown to occur also in calves (White and Minett).

(10) We are still in need of a rapid method of diagnosis if we are to bring home to all concerned the gravity of the situation. Although the guinea-pig test is slow, the results might be expedited and improved by duplicate or even triplicate inoculations, but expense is an overruling factor. More might be done by direct film examination from the udders of individual cows. In fact an improved bacteriological service would be a paying proposition from all points of view.

(11) The control of movements of positive tuberculin reacting cattle from farm to farm leaves much to be desired. Until this is done effectively there would seem to be little hope of dealing radically with the problem. Savage suggests segregation of positive reactors. This is based on the fact that positive reactors with no clinical signs are mostly in good health, giving normal milk and only occasionally excreting tubercle bacilli.

(12) More research is needed into the conditions of natural contagion in cattle. At present a clinically tuberculous cow must be slaughtered at once on diagnosis. A good deal might be learnt if greater possibilities existed under laboratory conditions for the study of the course of the disease, especially as regards the possibility of carriers, and the sources of infection generally-for instance, the presence of tubercle bacillus in nasal mucus and other discharges, urine and fæces; its survival time on naturally infected grass land, in the environment of cow stalls, in railway trucks and sidings; and its dis-semination by markets and agricultural shows have received but scanty attention in this country. Hitherto we have been chiefly concerned with the transmission of the bacillus from cow to man, and with the risks of pathogenic organisms other than the tubercle bacillus added during milking. It seems time we gave more attention to the passage of the tubercle bacillus from one animal to another. Shiel has recently shown in German herds, that cows may have tubercle bacilli in their bronchial mucosa before clinical signs are obtainable and that these cows act as "carriers", infecting other animals before they themselves are detected. There are records, too, of negative reactors becoming positive after a railway journey in infected trucks, and of negative reactors becoming positive after being sent to an agricultural show. The work of Maddock has shown that grass experimentally infected with bovine tubercle bacilli remains infective for nearly six months. If this can happen in an environment exposed to the sterilizing effects of sun, wind and rain, it requires little imagination to visualize what must happen in closed cattle sheds. The experience of Guernsey is instructive in this connexion. Bovine tuberculosis seems to have been unknown until 1902, and nonovine the ality ainly gitis.

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e n o for this reason, American cattle buyers purchased in the Guernsey market and came to exercise a great influence. In 1902 some cattle from Guernsey imported into the United States were found to be reactors and on inquiry in the Island it was found that in the previous year a local breeder had applied to the Royal Court of Guernsey for permission to bring back to the Island some cattle which he had sent to a show in England. Such a course was contrary to the Regulations then existing, but unfortunately permission was granted. These cattle were subsequently found to be suffering from tuberculosis and an outbreak of the disease occurred, which took some years to eradicate.

(13) Jordan estimated in 1933 that we were spending approximately half a million per annum in the treatment of the sick alone and another three-quarters of a million in wastage through condemned meat, and these items are by no means the end of the

story.

From the point of view of preventive medicine, the keypoint would appear to be efficient pasteurization with adequate bacteriological control.

Mr. R. E. Glover discussing the effective control of tuberculosis in cattle suggested a combination of the system of eradication by periodic tuberculin testing of infected herds and the elimination of reactors, with the system of vaccination with B.C.G. Where possible, the former method should be restricted to herds which were not extensively affected with tuberculosis, while vaccination should prove of great value in the densely populated dairying districts where infection was often heavy.

Under war conditions, and for some time afterwards, every effort would have to be made to conserve existing stocks. No great progress could be expected, therefore, in the eradication of the disease by the first mentioned method but there was some hope that vaccination would reduce the incidence of tuberculosis to such an extent that any infected animals which might still remain in the herds could be eliminated without

difficulty at some future period.

If B.C.G. was applied with the object of protecting calves as outlined in a previous paper (Glover, R. E., Vet. Rec., 1936, 48, 1329) the need for simple hygienic precautions should be stressed. This point was illustrated by reference to experiments carried out by Buxton, Griffith, Glover, Dalling and Bosworth at the Institute of Animal Pathology, Cambridge.

Dr. G. Gregory Kayne said that to those wholly engaged in clinical tuberculosis work, the bovine bacillus obtruded little in their consciousness. This was because its effects could not be distinguished clinically from those caused by the bacillus of the human type, so that one could not easily apportion the damage caused among human beings

by the two types of bacillus.

In discussing the control of tuberculosis in cattle as a disease inimical to man, the problems involved must be solved on the basis of peace-time possibilities, and any essential modifications in view of the war then made. We were dealing with a medical and veterinary problem closely bound up with social and economic considerations. Vested interests should be forgotten, otherwise, there would be introduced an unconscious distortion of facts which would falsify any conclusions formed. We were dealing with a very important and very urgent problem in the public health—how important and how urgent the general public and the medical profession appeared to ignore. The late Stanley Griffith at a meeting of the Tuberculosis Association in 1937 said: ". . . the latest findings in regard to this intractable problem should be made widely known, since they prove beyond any doubt that bovine tuberculosis is a serious menace which must be fought with the utmost vigour. The apathy of public opinion in this respect is astonishing in face of the incontrovertible evidence which has been published during the last quarter of a century by the scientific journals and made available to the general public in reports by a Royal Commission, the Minister of Health, the People's League of Health and individual workers." This was plain enough, and the first question must therefore be—why this apathy of public opinion?

Dr. Gloyne had given figures of incidence of bovine tuberculosis in man, but these collected statistics were not very recent, and were based on a relatively small number of cases in relation to the large number of people suffering from the disease. What was the true incidence of bovine infection in man at present, and was it decreasing or increasing? There seemed no reason why recent figures on a large number of cases should not

be made quickly available.

What was the incidence of infected cattle in this country? The figure of 40% was constantly met in the literature; it seemed to be repeated from book to book, and paper to paper. He had traced it to Sir William Savage's Mitchell Locure in 1933, where he stated: "... on the basis of the tuberculin test the percentage of cows infected with the tubercle bacillus is extremely high. The distribution is rather variable, and may vary from 10 to 80%, but for cows in England as a whole it cannot be put below 40%."

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An accurate estimate seemed important, because this 40% was constantly thrown up as a decisive reason for not applying the eminently successful American method—so successful that a case of tuberculosis in a child due to the bovine bacillus was now considered rare enough to deserve publication on that score alone. This method consisted in slaughtering all reactors and paying compensation to owners. It was claimed that the application of this method here would cause a very serious shortage of milk, and embarrass the farming industry. Which was considered the greater obstacle, the first or the second?

If this method were adopted, for some time to come safety could be obtained only by means of universal pasteurization. Why was it that the Bill that would have led to this was rejected before the war in spite of all the evidence on the effects of tuberculous milk in human beings? Ontario was the *first* large area in the British Empire to introduce compulsory pasteurization.

And lastly, Dr. Kayne added, why was there no propaganda that milk which had not been pasteurized should be boiled before it was given to children? Were the English less intelligent or did they care less for the welfare of their children than the Spaniards or the French? In a survey made some ten years ago in several rural districts in France, Hazemann found that out of 442 children not breast fed, only 21 did not have their milk boiled.

Mr. H. W. Steele-Bodger expressed the view that the method of control of tuberculosis whether by eradication or immunization, would depend upon the character of the herd and the incidence of the disease in the area under consideration.

He did not think that it was possible to compare the conditions prevailing in the U.S.A. with those which obtained here. The incident quoted of tubercle infection having been set alight on the Island of Guernsey following exhibition at a show demonstrated the necessity of elaborating an efficient immunizing agent. He instanced one farm in his own practice on which, following an outbreak of foot-and-mouth disease, the farm had been restocked with an entire herd of tuberculin-tested pedigree Ayrshires, which, between the twelfth and eighteenth month after purchase, became infected with tuberculosis and at one test about forty of the fifty-six cows reacted and an approximately equal proportion of the young stock. It was unfair to submit the stockowner to these grave risks. He was encouraged to hear Professor Dalling and Mr. Glover plead for the use of an immunizing agent in heavily infected areas and he wished to associate himself with this.

Over a period of ten years Mr. Steele-Bodger said he had used B.C.G. vaccine on some thirty-three herds and he was satisfied that this vaccine conferred a high degree of resistance. He pressed for field trials using B.C.G. and the vole organism.

Pasteurization did nothing to remove the trouble at its source. Routine clinical examinations of herds was of great value. In the County of Stafford, the late Dr. Menton had reported that regular biological examination of milk from herds subjected to quarterly clinical examination showed an incidence of tubercle infection in the milk of 0.5% compared with an incidence of 5% in the milk of herds not so examined.

Lt.-Col. G. Rees-Mogg said that he had tried the Calmette-Guérin vaccine on his herd for about twelve years, but had given up using it two years ago, as he had come to the conclusion that it did not give any immunity. In Ottawa six years ago, he saw in Professor Watson's laboratory organs affected with tuberculosis, from animals which had been vaccinated with Calmette-Guérin vaccine.

The speaker also pointed out that once the animals had been vaccinated, they would not pass the tuberculin test, and so there was a great financial loss.

Dr. H. H. Green said that with reference to the comments of previous speakers on the difficulty of diagnosis of tuberculosis in dairy cows, and in particular of distinguishing between mammalian infection, avian infection, and other infections such as Johne's disease, by the recognized tuberculin test, it might be of interest to draw attention to certain recent work at the Veterinary Laboratory of the Ministry of Agriculture at Weybridge. The biochemical department had been conducting studies upon the changes in composition of synthetic media during the growth of various acid-fast organisms, notably human, bovine and avian strains of tubercle bacilli, B.C.G., Johne's bacillus and the non-pathogenic M. phet. The tuberculin department had been subjecting various protein derivatives or pared in the course of this work to comparative biological tests with the ultimate object of utilizing them for differential diagnosis of natural infections.

Dr. A. Eden said the introduction of synthetic media of the asparagine-glycerol type in place of the chemically complex glycerinated broths as previously employed for the manufacture of tuberculins had opened up a ready means whereby tuberculins could be standardized. All available evidence showed that the active fraction of tuberculins is of

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a protein nature, and this is readily capable of chemical standardization by precipitation of the protein with trichloracetic acid and the determination of the nitrogen content of the precipitate. At the Veterinary Laboratory, Weybridge, chemical studies of the changes undergone by human type M. tuberculosis growing on synthetic media showed that by the end of eight weeks' growth practically all the glycerol, dextrose and amide nitrogen fractions disappeared from the media and that there was a huge production of ammonia and a gradual production of water-soluble, non-coagulable protein in the medium equivalent to as much as 0.15 g. protein per 100 ml. original medium. Similar studies carried out with avian type M. tuberculosis showed essentially similar chemical changes in the medium except that the production of the active, water-soluble protein was only one-third that of the human types.

Since tuberculins were prepared by heat concentration of the bacteria-free culture media at the end of growth, the potentialities of the two types, human and avian, for tuberculin production were very different, and assuming proportional losses in manufacture, such human type tuberculins would be three times as potent as the corresponding avian type, apart from the question of specificity.

The chemical method of standardization had been shown in repeated tests at Weybridge to run parallel with biological standardization and was obviously much more accurate. Further it was possible to isolate the respective proteins as dry powders (Purified Protein Derivatives or P.P.D.s.) and by the simple method of solution in adequate buffer with suitable preservatives it was possible to prepare tuberculins for intradermal tests of any desired potency, and thus one variable in a number of unknown variables could be stabilized. Biological tests with such P.P.D.s reconstituted to the same protein concentration as any homologous tuberculin showed a strict parallelism. Thus chemical analysis of tuberculins was an important factor in assessing the potency of a particular batch.

Mr. J. Reid (Weybridge) said the work he had done with the P.P.D. preparations was undertaken in order to study whether by using the graded Mantoux intradermal test on suitably sensitized guinea-pigs it was possible to assess the degree of relationship in specificity between the various purified protein derivatives of the members of the acid-fast group of organisms. In other words they set out to study how many units of the heterologous product were required to stimulate a dermal reaction of intensity equal to that produced by one unit of the homologous protein, the homologous product being derived from the type of bacilli used to sensitize the test animals.

Group of guinea-pigs sensitized with human type tubercle bacillus; approx. test values obtained:

One unit of human P.P.D.

unit bovine P.P.D.

unit B.C.G. P.P.D.

unit B.C.G. P.P.D.

unit bovine P.P.D.

one unit of human P.P.D.

unit bovine P.P.D.

one unit of human P.P.D.

Group of guinea-pigs sensitized with avian type tubercle bacillus; approx. test values obtained:

One unit of avian P.P.D.

20 units human P.P.D.
20 units bovine P.P.D.
5 units johnin P.P.D.
100-200 units phiel P.P.D.

The result of these tests to date indicated that it might be possible, by applying the graded intradermal test with selected doses, to group infections into: (1) Mammalian, consisting of human, bovine, and variants of these two types; (2) avian which would include Johne's; (3) the non-pathogenic group of acid-fast organisms.

Dr. C. L. Oakley said that the expectation that pasteurization could be abandoned when the incidence of tuberculosis in cattle was greatly reduced appeared to him illusory, as it would still be difficult to prevent the infection of milk during and after collection. He hoped that pasteurization would always be retained.

Mr. H. R. Tinney referred to remarks by Professor Dalling and other speakers concerning certain failures which occur in tuberculin testing.

He drew attention to an article by Dr. L. B. Bull in the Australian Veterinary Journal for April 1941 based on investigations carried out by Legg and Maunder in Queensland. In one series of experiments 865 cattle were tuberculin tested, the results showing approximately 11% to be affected. These cattle were examined post mortem. 1.5% of non-reactors showed small lesions post mortem and 1.8% showed moderate to advanced or generalized lesions. Those animals showing lesions were divided into three categories: (a) Generalized cases; (b) those showing moderate to advanced lesions; (c) those with small lesions. Reactors in the above categories were (a) 68%, (b) 86.5%, and (c) 50%.

The speaker commented that no indication was given as to the character of the lesions and, therefore, the apparent poor results obtained in respect of (c) may possibly have been due to the inclusion of small, calcified abscesses. The results were alarming in so far as the most serious cases gave poor results on testing and further investigation was

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undertaken at the instance of the Tuberculin Committee of the Australian Veterinary Association. Sera from 13 cattle with tuberculosis, but which had failed to react, were submitted to A. D. Campbell of the Animal Health Division, C.S. and I.R. 11 were from advanced cases and 2 from cases with early lesions. Campbell obtained a positive complement-fixation reaction from all the advanced cases. Of the other two, one gave a weak or doubtful reaction and the other was negative. Five other sera which were tested all gave positive reactions though three of these showed early lesions only.

Dr. Chalmers Watson asked if Professor Dalling had any grounds for thinking that any of the National Foods, now of necessity used for the feeding of dairy stock, might be proving definitely injurious by infecting the healthy stock in the Attested Herds of the country? He asked this very important question because it had come recently and acutely under the notice of the Scottish Association of Certified and T.T. Milk Producers.

A general observation that the speaker wanted to make had reference to the lack of confidence that was widespread in the industry at the present time in relation to the present tuberculin test used in the attested herd scheme, and to the urgent need for adequate steps being taken to restore speedily the confidence of the industry in the tuberculin test. It was unfortunate that the new test introduced in May 1940 had, with good reason, been the subject of so much serious criticism, largely as the result of its being prematurely introduced, without conforming to use and wont, by securing the interest and co-operation of herd owners and of the veterinary profession in relation to new legislative and administrative measures. It was, however, satisfactory to learn that before long a pronouncement from the Agricultural Research Council, with the co-operation of the Joint Tuberculosis Committee, would be forthcoming, this being essential for restoring the confidence of the industry in the value of the tuberculin test employed.

#### [February 4, 1942]

# OISCUSSION ON THE CONTROL OF TUBERCULOSIS IN CATTLE— (1) BY IMMUNIZATION; (2) BY ERADICATION OF INFECTED ANIMALS (Continued from December 17)

Mr. H. T. Matthews: There have been many attempts to create an immunity or to minimize the effects of bovine tuberculosis by artificial means. In general, vaccination with killed organisms has been found unsuccessful but claims are made for living vaccines modified in various ways. Von Behring used a human type, B.C.G. has received notice and attention is now being directed to the vole bacillus. Although reports conflict, there seems to be general agreement that resistance to infection can be enhanced and also that, even if infection should occur, its spread in the body can be impeded or arrested.

The oldest organized attempt to eradicate tuberculosis from infected herds is probably that known as Bang's method. It has been practised mainly in Denmark, Austria and Hungary and relies on the infrequency of congenital tuberculosis. It involves the segregation of calves from birth, so forming a new herd to replace the original within a few years. Its practicability has been demonstrated, even when only one set of premises is available and the adult herd heavily infected. Ostertag's system has been applied principally in Germany, Switzerland and Sweden and comprises elimination by slaughter of cases which are detected by clinical examination reinforced by laboratory test of specimens. It is reported that the application of the system has failed to bring about any reduction of bovine tuberculosis in Germany. The radical systems, based on the use of tuberculin with the elimination of reactors, have been employed extensively in America and Canada. In the United States, twenty-five years of intensive attack have resulted in a reduction of incidence from an average of 5% to under 0.5%. The Canadian plan is similar but rests more on voluntary than compulsory application. Incidence was rising from 3% in 1910 to over 7% in 1925. The scheme in its present form was initiated in 1922 and the incidence is now under 2%, although only about one-third of the total cattle are included in official measures yet. In Great Britain the Attested Herds Scheme is on a voluntary basis and deals only with individual herds.

There are three distinct methods of direct attack which could be applied singly or in combination; artificial immunization, separation of young stock from infective surroundings and the weeding out of infection by the use of tuberculin. Examination of conditions in Great Britain shows them to approximate in most respects to those prevalent in Europe rather than on the American continent and the immediate problem is how to reduce the disease in preparation for the more distant objective of total eradication. The stimulus to activity in the past has been the danger to human health, and much

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good work has resulted, but we cannot be certain whether tuberculosis in cattle is greater or less than it was twenty-five years ago. The primary motive of the future will lie in agricultural economics, even though tuberculosis is not the most expensive disease to stockowners.

It is argued that, on the factor of comparative incidence alone, methods followed in America are not applicable here. The figure 40% has been quoted as representative of incidence in dairy cattle. There are districts in Great Britain where the incidence approximates to 100% and others where it is correspondingly low. The density of the cattle population ranges from under one hundred to over four hundred and, fifty per thousand acres of cultivated land; it is highest in Cheshire and lowest in the Cambridge arable country. The proportion of dairy to total cattle ranges from under 20 to over 95%. The ratio of young stock to adults, dividing at 2 years old, varies from 20 to 60%. There is reason to believe that the distributional incidence of tuberculosis is not less variable. Using tuberculin as a diagnostic agent, Montgomerie and Rowlands found 11-8% reactors in a North Wales district, Thomas 2-6% in South Wales, Rabagliati 7-6% in a part of Yorkshire. The conception of a uniform 40% incidence as a total bar to the application of American methods is therefore misleading.

Discussion might be directed to considering the practicability and probable effects of applying three distinct methods of control simultaneously: in districts where the incidence is low, extension of the Attested Herds Scheme to areas on American lines, based on the use of tuberculin; in districts with medium incidence, the promotion of calf nurseries, either co-operative or State-owned, with the intention of replacing whole herds by new ones from the calves reared free from disease; in districts where the incidence is high, the use of living vaccines in an attempt to reduce the effects of disease and the number of grossly infective cases.

Dr. R. F. Montgomerie: The medical man who sees the tragic effects of bovine tuberculosis infection on the child population of this country must, naturally, tend to demand the eradication of tuberculosis from the cattle population. The destruction of all infected cows is an impossible programme. To have the desired effect slaughter would have to be completed within a relatively short period, otherwise the remaining infected animals would soon spread infection to hitherto clean cattle and the slaughter within a short space of time of any proportion of infected cows appropriate to progress in national eradication would affect the fertility of our land to a disastrous extent and reduce the amount of milk available for human and animal consumption to an impossibly low level. As the position is I do not see any hope of a policy of slaughter of tuberculin positive reactors being practicable in this country until, by other means, we have greatly reduced the incidence of the disease.

We can, however, segregate our infected animals from our clean and this policy has been in operation for some few years and is in my view the correct policy for this country. The greatest hindrance to the establishment of tuberculosis-free herds is due to the apathy of the public in not demanding milk from tuberculosis-free herds and in not being prepared to pay a fair price for it. There are other lines of attack and I agree that vaccination holds promise and may become a potent weapon. I would, however, be interested to hear discussed what we expect of vaccination in tuberculosis. Until we know more about vaccinal reaction to the tuberculin test and can distinguish the vaccinated "clean" animal from the vaccinated "infected". I doubt very much the progress which will be made by vaccination if we have to accept that it will not prevent infection. One can also say that much more active and extensive work is still to be done before veterinary tuberculin and the test itself is in a satisfactory position. Despite its deficiencies and past imperfections, it has aided the eradication of tuberculosis from many herds in this country.

Dr. H. H. Green: In contributing to the adjourned discussion from the previous meeting it may be of interest to refer to the chemical nature of tuberculin and in particular to the purified protein derivatives (P.P.D.) which are now being advocated in place of the earlier heat-concentrated bacterial filtrates. "P.P.D." and "P.P.D. tuberculins" of sufficient purity for all diagnostic requirements are little more trouble to make than "heat concentrated tuberculins".

When Mycobacterium tuberculosis is grown in any suitable liquid medium protein derivatives find their way into solution along with other products of bacterial metabolism, while the medium itself undergoes various chemical changes. Koch himself held that the active principle of his "old tuberculin" was protein in nature although the difficulty of separating protein of bacterial origin from protein derivatives in the original broth rendered further investigation difficult. With, however, the introduction of protein-free synthetic media of the glycerine asparagin type any protein found after completion of

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bacterial growth must necessarily be of bacterial origin and Seibert showed that several soluble proteins were present in the filtrate from the bacterial debris, all of which had tuberculin activity, while any non-protein constituents were not specifically, active although they might show certain non-specific toxic properties.

The proteins of highest molecular weight were coagulated by heat and were antigenic, while those not coagulated by heat were of lower molecular weight and so feebly antigenic as to cause no complications in the routine intradermal test. Because of the method of heat concentration these simpler protein derivatives were the "active principle" of the older "tuberculins".

Knowing these facts the preparation of P.P.D. tuberculins of sufficient purity for all practical purposes becomes simple. After growth of any desired strain in any suitable synthetic medium is completed, the culture flasks are heated to kill the organisms and throw down the unwanted coagulable protein. This coagulated fraction remains with the bacterial bodies on filtering, so that the filtrate contains only the "heat-denatured noncoagulable non-antigenic soluble protein derivatives". If to the clear bacterial filtrate any good protein precipitant is added, this "P.D." is thrown out. Trichloracetic acid is used at a concentration of about 5%, partly because it effects complete precipitation and partly because it is very easy to get rid of in subsequent purification to "P.P.D." of the polysaccharide associated with the protein is split off by the trichloracetic acid although, at the pH concerned, some of the nucleic acid in the medium comes down as "protein nucleate". If the precipitate is washed a few times with dilute trichloracetic acid the other non-specific constituents of the medium are removed and the trichloracetic acid itself can then be washed out with water, either plain or buffered around the iso-electric point of the protein. This leaves a wet P.P.D. which can be redissolved in dilute soda, brought to approximate neutrality with phosphoric acid, so providing a "phosphate buffer", standardized to any desired strength by Kjeldahl N. determination, fortified with glycerine as stabilizer and phenol as preservative, and issued as "P.P.D. tuberculin". If so desired, allowance can be made for the nitrogen present as nucleic acid by calculation from the phosphorus content. If the P.P.D. is wanted in the dry state the trichloraceticwashed precipitate is triturated with successive portions of anhydrous ether, which removes both trichloracetic acid and "wetting" water, and finally dried in a vacuum desiccator. The dry product so obtained usually contains about 90% of true tuberculoprotein derivative, the remainder consisting of nucleic acid, polysaccharide, and residual moisture. If a higher degree of purification is required the "P.P.D.", while still at the wet stage, can be redissolved in dilute alkali, neutralized, and precipitated with ammonium sulphate. Very little nucleic acid is precipitated around the neutral point and this component, along with most of the residual polysaccharide, is so got rid of. If desired this precipitation can be repeated several times, the ammonium sulphate dialysed away and the product dried. In her latest technique Seibert reprecipitates seven times but even this leaves traces of nucleic acid and polysaccharide. For commercial biological purposes this more extensive purification is unnecessary, although of course desirable for subsequent studies on the chemistry of the proteins concerned.

No mention has been made of the "ultrafiltration washing and concentration" of Seibert. Such a technique is useful for concentration purposes but is not an essential step in the preparation of a sufficiently pure "reconstituted P.P.D. tuberculin". It saves trichloracetic acid but is more troublesome, and in large-scale production for veterinary requirements would be used or omitted according to the economics of the matter.

"P.P.D.s" of various acid-fast organisms have been prepared in the biochemical department at Weybridge and tested for specificity in the tuberculin department. The series included products from human, bovine, and avian strains of *M. tuberculosis*, from B.C.G., from Johne's bacillus and from *M. phlei*. Since these keep well in the dry state they also serve as provisional standards for potency tests on any other products subsequently prepared.

In testing any given "tuberculin" it is obviously necessary to distinguish between "potency" and "specificity" and in doing so the following definition of terms has been adopted:

Potency factor.—The number of units of the unknown preparation, in prescribed volume of test dose, required to elicit the same skin reaction as one unit of a selected reference standard (P.P.D.) in specified experimental animals sensitized to a bacterial strain homologous to that from which the standard was prepared.

Specificity factor.—The number of units of heterologous protein derivative required to give the same intensity of skin reaction as one unit of homologous protein derivative, i.e. homologous to the species of acid-fast used to sensitize the experimental animal.

In the case of "purified protein derivatives" which can be weighed out in the dry state comparison is of course made direct. In the case of solutions the protein derivative can be determined analytically and the figure used for calculation on a protein basis.

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In the series of specificity tests at Weybridge the guinea-pig has been used as the experimental animal but observations on the bovine subject have also been made and will be extended further.

As a broad preliminary generalization it may be stated that the "specificity factor" as between protein derivatives from strains of M. tuberculosis of mammalian origin is comparatively small—about 2. Thus with guinea-pigs sensitized to a human strain 2 units of P.P.D. from B.C.G. were sufficient to elicit the same intensity of skin reaction as 1 unit of P.P.D. from a mixture of three human strains. Human strains amongst themselves seem to show little or no specific difference. On the other hand the specific difference between any of the mamalian P.P.D.s and an avian P.P.D. or a johnin P.P.D. is comparatively wide, the factor being about 20 to 40; while the specific difference between either mammalian or avian and phlein is much wider still, the factor being about 100 to 200. The specific difference between avian P.P.D. and johnin P.P.D. is again small, factor about 5.

The practical result of these observations is that comparative intracutaneous tests with specific purified protein derivatives readily differentiate between infections with mammalian and avian strains of tubercle in the guinea-pig and, in so far as present observations have gone, also in cattle. The specificity factor as between avian P.P.D. and johnin P.P.D. nas not yet been determined on cattle but unless it is wider than the figure 5 shown in guinea-pig tests it may not prove easy to distinguish between avian tuberculosis and

Johne's disease.

In actual practice the most important differentiation to make is that between bovine and avian infection of dairy cows. In many cases simultaneous comparison of two reaction sites with selected "average doses" of P.P.D. may be sufficient but the degree of certainty would be very much enhanced by comparing four standardized injections, i.e. two of each P.P.D. at widely divergent concentrations, so as to allow for the very wide variations in "allergic status" commonly encountered in individual members of a herd or in the same individual at different times.

Dr. H. J. Parish said he did not agree with Dr. Montgomerie when he blamed the apathy of the general public for the unsatisfactory state of our milk supply. If the dangers of tuberculous milk were fully appreciated throughout the country, the public would be prepared to pay for improved methods of control. If milk containing dangerous organisms had been sold to the public surely it was not the public but the Government departments concerned which were responsible. At the previous discussion the point made by the medical contributors was that the outstanding practical measure in the control of our infected milk supply was efficient pasteurization. The sale of infected milk surely ought to be a criminal offence, but unfortunately it was not so regarded.

Mr. H. W. Steele-Bodger said that for a number of years he had persuaded his clients to create tubercle-free herds; there had been no difficulty in getting the herds free but it had been found impracticable and uneconomic to keep them free; there were so many limiting factors outside the control of the farmer. All animals imported into these tubercle-free herds had come from free areas but invariably they were the first to succumb to infection and became reactors to the tuberculin test, usually after an interval of six months. There were too many heavily infected areas in this country to be restocked from the free areas. He urged that methods of immunization should be more fully investigated and if found to be sufficiently reliable, a policy of immunization should be adopted, at least in

the heavily infected areas.

In 1927 he commenced vaccinating with B.C.G. in some 30 herds, but the number had, for various reasons, dwindled. The total number of vaccinated calves he had done was 1,538 with 3,170 re-vaccinations—a total of 4,708. He had made only 30 post-mortem examinations himself; of these 22 were entirely negative, three showed calcified lesions in the glands and five were advanced. These figures might appear far from satisfactory but so were the conditions under which these field trials were conducted. Only the subcutaneous route was utilized in immunizing the calves. No effort was made to keep them in isolation either before or after they were injected. It had proved very difficult to follow many of the vaccinated animals to the slaughterhouse though he had received, but treated with reserve, a great deal of information from sanitary inspectors, butchers and others as to the freedom from tubercle infection of vaccinated stock.

Lieut.-Colonel H. A. Reid said that he could not agree with the statement of a previous speaker that failure to lead public opinion had accounted for many of the present difficulties. It was not the fault of the medical or veterinary professions who with the help of the press had done all that was possible to educate the public on the subject of tuberculosis. The belief in the hereditary nature of tuberculosis was still widely held. Because milk looked clean and wholesome people did not hesitate to consume it in the

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raw state and give it to children. His attempts some years ago in New Zealand to supply clean, tubercle-free milk produced under modern hygienic conditions had not been encouraging and had resulted in financial loss.

Dr. J. T. Edwards (Pirbright) reverted to the experiences related by Colonel Rees-Mogg at the close of the preceding meeting from which the conclusions were drawn that B.C.G. vaccination proved unavailing to diminish the incidence and intensity of tuberculosis in a herd of Friesian cattle. Experiences of that kind needed careful examination. McFadyean and his associates (J. Comp. Path. & Therap., 1901, 14, 136; ibid., 1913, 26, 327) repeated von Behring's work and compared it with vaccination in a similar way with tubercle bacilli of the avian type, inasmuch as the excretion of live human bacilli was anticipated to be fraught with obvious danger to the human consumer of milk from the vaccinated cattle. The conclusions drawn that "by the intravenous inoculation of avian bacilli it is possible to confer on healthy calves a markedly increased power of resistance to infection with bacilli of the bovine type" seemed to have settled in principle the reality of vaccination. Nevertheless (unpublished results) the later findings that intravenous injection with some strains of avian tubercle bacilli was not always safe for cattle, together with other obvious objections to the method (such as infection of poultry with the excreted bacilli) did not afterwards commend it for adoption in practice. The researches of Wells and Brooke on guinea-pigs and the preliminary experiments of Dalling and Griffith on cattle, with the vole bacillus, renders the situation still more hopeful. In comparison, despite its almost complete innocuousness for cattle and man, B.C.G. would seem on the whole to constitute a rather weak antigen. Reviewing the published evidence, and taking into account his personal experiences the following conditions appeared to be essential for the success of vaccination of cattle against the bovine tubercle bacillus: (1) Vaccination must be adopted only on animals that are free from the natural infection. In naturally heavily infected herds, this would mean that vaccination should be undertaken only on newly born calves. (2) A period, which may prove to extend to three months (unpublished personal observations) must elapse after vaccination before the calves are allowed to become exposed to natural infection. (3) The immunity appears to wane quickly after the vaccinating bacilli are excreted from the animal's system, and so vaccination needs to be repeated at intervals not exceeding about nine months. (4) The immunity is not a very powerful one, and so the animals need to be excluded throughout life from risks of massive infection.

While expressing much hope for the chances of vaccination in selected circumstances, well-thought-out trials on a field scale should first be carried out before the method was adopted in general practice.

In reply Mr. H. T. Matthews said that at least two types of regions in Great Britain were recognized as requiring different treatment: those where incidence of tuberculosis was high and those where it was low. The problem of disposal of reactors to tuberculin would be met by permitting free sale out of eradication areas into those areas where reduction of disease was the immediate aim but not vice versa.

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## Section of Epidemiology and State Medicine

President-E. H. R. HARRIES, M.D.

[March 27, 1942]

### DISCUSSION ON PRIMARY TUBERCULOSIS IN ADOLESCENTS AND ADULTS

Dr. G. Gregory Kayne: Primary tuberculosis in adolescents and adults has attracted much attention in recent years. Unfortunately clinical speculation is tending to outstrip known pathological facts. Yet, since the epidemiological implications may be far reaching in guiding control of the disease, basic facts should be clearly defined. There is no unanimity on the age at which adolescence begins; for this discussion, however, we shall take it as 16. The definition of primary tuberculosis requires more emphasis. Clinicians are still in doubt which lesions to call primary and which post-primary; some have gone so far as to state that those which develop within a year of the onset of tuberculin sensitivity should be termed primary and others, reinfection lesions. It is thus not surprising that theory-building on the basis of radiological shadows has led to widely differing conclusions. Among children primary infection is always followed by the complex of pulmonary and hilar foci, yet this cannot be detected radiologically in more than 25% either because of its small size or its position (Slooff, 1937). Hence primary tuberculosis must be defined on a strictly pathological basis, and it must mean the first lesion in the body following the introduction of tubercle bacilli.

Historical note.—Naegeli's classical post-mortem investigations (1900) in Switzerland showed that nearly all adults had been infected with tuberculosis. The Pirquet test appeared to confirm these findings as 95% of Viennese children were positive to the test at the age of 13. It was admitted that in country districts the incidence of infection might be lower, but it was generally considered that by adolescence nearly everyone had been primarily infected. Pulmonary tuberculosis in adults, spreading by the bronchi (and therefore suitably termed bronchogenic tuberculosis), was believed to have its origin in renewed activity of tubercle bacilli in the primary lesions or in those that immediately followed the primary infection in children. Later it was added that this bronchogenic tuberculosis might arise also as a new exogenous infection which remained confined to the lung owing to the allergy that followed primary infection. The greater incidence of tuberculosis among adult home-contacts than in the general population was adduced as evidence in support of this view.

The tuberculosis seen during the first world war in soldiers brought to Europe from communities among whom tuberculosis was not endemic, showed that primary infection did occur in adults, and that it could assume a generalized and rapid form. This was did occur in adults, and that it could assume a generalized and rapid form. explained as due to the fact that, unlike Europeans, these natives had had no opportunity of being primarily infected in childhood, and therefore of developing the immunity that Actually, as was shown in connexion with South Africans on followed such infection. the Rand, this was not the true explanation, but in any case the above phenomenon was not related to European adolescents, though as early as 1919 Ghon and Pototschnig reported finding recent primary infection in adults post mortem. This finding was considered exceptional. And it was not until 1927, when Heimbeck in Oslo published his work showing that a large proportion of student nurses were tuberculin-negative, that primary tuberculosis in adults began to attract attention. Accurate pathological evidence was provided by Ragnotti (1930) who, among 4,000 consecutive post-mortem examinations at all ages in Berlin, found 36 cases of recent primary complex, in adolescents and adults, both pulmonary and intestinal, the largest number occurring in the age-During the last twenty years publications have multiplied enormously, although apart from the excellent monograph by Frimann-Dahl and Waaler of Oslo (1936), little has been added on the pathological aspect.

The earlier epidemiological investigations came almost exclusively from Scandinavia, Heimbeck being followed by Arborelius (1930) in Stockholm (among recruits, the Mantoux test being used), Heckscher (1931) in Denmark (also among recruits). Kristenson (1932, 1933) in Upsala (among nurses), and a little later, Holm (1934) among the general population in Denmark. Physicians in the United States soon became interested. Their work was carried out mainly among students and nurses. Studies have also been published from

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France, where unfortunately the Pirquet test is still extensively relied on, and from South American countries. The best investigation is undoubtedly that of Malmros and Hedvall

(1938) among students and nurses in Lund, Sweden.

Perusal of the literature shows that in some countries a large proportion of the population reach adolescence without having been infected with tuberculosis, and that primary infection occurs during adolescence and adult life following contact. Granting this, several questions at once present themselves: (1) What is the incidence of tuberculous infection when adolescence is reached? At what rate does primary infection occur later? On what factors does this rate depend? (2) Are the morbid anatomical lesions of primary infection the same in adolescents and adults as in children? Is the subsequent morbid anatomical evolution the same as in children? (3) What are the clinical, including radiological, manifestations of primary tuberculosis in adolescents and adults? Is the subsequent clinical course the same as in children? (4) What are the epidemiological implications? How far will the mortality in different age-groups be affected by the fact that more and more people receive their first infection in adolescence? I shall attempt to answer these questions very briefly on the basis of published work in other countries (since unfortunately none is available here), and I have collected representative samples in the following table, ignoring those investigations in which the Pirquet test alone was used:

#### Incidence of Tuberculous Infection in Adolescents

#### TABLE I.

Author	District	Material : character and number	Tuberculin test	Percentage negative
Arborelius (1930)	Sweden	2,230 recruits, mainly aged 19-21	Mantoux 1 mg.	34'2% from country; 4'8% from Stockholm
Holm (1940)	Denmark	1,500 medical students	Mantoux P.P.D. 2nd strength	3300
Soper and Wilson (1932)	Yale Univer- sity U.S.A.	3,000 undergraduates	Mantoux 1 mg.	45.5%
Long and Seibert (1937)	U.S.A.	College entrants in various parts of the country	Mantoux P.P.D. 2nd strength	From 20% to 80%: high nega- tive rate in Central States, low rate in Eastern States
Stiehm (1939)	Univ. of Wisconsin U.S.A.	Students: (1) aged 16 (2) aged 20	Mantoux P.P.D. 2nd strength	81 % 73 %
J. A. Myers et al. (1940)	Minneapolis U.S.A.	Student nurses and edu- cation students (entrants)	Mantoux 1 mg.	70% to 85% according to school
Israel et al. (1941)	Philadelphia	643 nursing students, aged 17-21	Mantoux P.P.D. 2nd strength	43%
Sayago and Casco (1939)	Argentine	279 students, aged 19-22	Mantoux	21%
Vaja (1939)	Roumania	College students, aged 18	Mantoux	46%

From these and other published studies it is evident that while in some urban localities the percentage of infected people may be as high as 80% at the age of 20, in many it is no higher than 40%, and may be as low as 20%. These figures will clearly be lower at the age of 16, the onset of adolescence. The incidence of infection at this age varies directly with density of population and height of tuberculosis mortality. Repeated tuberculin testing in the same district after an interval of a few years, for instance, in Norway (Ustvedt, 1932), in Holland (Heynsius van den Berg, 1934), and in America (Tenth Annual Report of the Tuberculosis Committee, American Student Health Association, 1939-40, Journal-Lancet, 1941, 61, 115), suggests that the incidence of infection has fallen in recent years with the fall in tuberculosis mortality. Thus data obtained from 166 colleges in America show that the percentage of students tuberculin positive has more or less gradually fallen from 35% in 1932-33 to 25% in 1939-40. A fall in rate of infection during the past twenty-five years has also been clearly demonstrated in the morbid anatomical material of Frimann-Dahl and Waaler (1936) in Oslo, compared with that of Harbitz in 1904; and in the post-mortem investigation of Uehlinger and Blangey (1937) at Zurich, compared with those of Naegeli in 1900. It may therefore be concluded that at least half the people in civilized communities first become infected with tuberculosis after adolescence has been reached. The rate at which infection occurs from then on appears to depend on opportunities for contact with the disease. Published investigations suggest that most of the late primary infections occur between 16 and 30. While among the general population the increase in incidence of infection is more or less gradual, among certain groups exposed to special risks the increase may be very rapid. Thus medical students and nurses previously tuberculin-negative are usually all infected before qualification, and half of them may become tuberculin-positive within a few months when working in tuberculosis wards. The investigations of Stewart et al. (1939) have shown a very striking difference between the rate of increase in infection among the above groups and that among other college students. Thus, allowing for length of exposure, the attack rate was among medical students attending a two weeks' tuberculosis

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service, twenty-eight times that among students of a college of education. Similarly, the attack rate among nurses attending a six weeks' tuberculosis service was twelve times that among those not attending such a course. Hedvall (1940) gives similar findings among student nurses at Lund, Sweden, and shows that the greatest conversion rate of tuberculin reaction among medical students occurs during the course in morbid anatomy.

It would be inadvisable to apply too closely the findings from one country to another. One must therefore regret that so far no related investigations have been published in this country. There are indeed only three investigations on the incidence of infection among non-tuberculous people, and these deal with relatively small numbers, and only with hospital patients; moreover they were carried out eight to thirteen years ago (Hart, 1929; Dow and Lloyd, 1931; Kayne, 1934). They do suggest however that ten years ago an appreciable proportion of adolescents had not been primarily infected.

Quite recently figures have been published, though again concerning small numbers, by Crowe (1942) from Eire. The tests were carried out in the County of Laoighis, where no less than 56% were found negative to a complete tuberculin test among the age-group 15-20, and even 33% among the age-group of 20 and over

#### Morbid Anatomical Note

In an adolescent or adult the primary lesions are similar to those that develop in children. But there are differences: unlike in children, caseation in the corresponding hilar glands may be less extensive than in the pulmonary focus; and presumably because of this, epituberculous lesions, so common in childhood, and due either to collapse or to perifocal inflammation, are seldom observed. The evolution of the disease differs but little from that seen in childhood, from its most favourable outcome—calcification of the primary complex—to the unfavourable disseminations, both—acute and chronic. There is one difference. In adolescents and adults, within a comparatively short time of the apparent healing of the primary complex, whether insignificant or extensive, lesions typical of bronchogenic tuberculosis may develop. This has been demonstrated in all relevant morbid anatomical material available. This fact cannot be overstressed, since it is evident that when the primary lesions are insignificant and not demonstrated clinically, the onset of lesions of the bronchogenic type within some months of the change in tuberculin reaction, might be regarded by the clinician as a form of the primary lesion itself. This indeed has recently been assumed by some American physicians (see below).

#### Clinical Manifestations

In order to study these with accuracy, much published work is of little value. Only such investigations should be considered in which certain criteria have been adopted. These are: (1) a complete tuberculin test, if negative, should be repeated at least once a year (preferably every six months); (2) a full-sized radiograph should be taken when the tuberculin reaction becomes positive, and repeated at short intervals; and (3) a film, taken before the tuberculin reaction became positive, should be available for comparison. The need for a complete tuberculin test should be obvious; and stress must be laid on the criteria adopted in regarding a reaction as positive—these must not be fixed too low. Repetition at short intervals is essential; otherwise difficulty will arise in dating clinical manifestations. Screening is not reliable enough for the detection of very small Jesions; and a film taken when the tuberculin test was negative, for comparison, is necessary in order to appreciate slight enlargement of the hilar shadows. The investigation that fulfils these requirements best is that of Malmros and Hedvall from Lund, Sweden, and I shall, therefore, briefly summarize their findings among students and nurses.

Among those who became tuberculin-positive during the period of observation—a total of 151—only 47, representing 31%, showed clinical manifestations. These were all aged between 20 and 25; and the incidence of manifestations was much higher among medical students and nurses than among students of other faculties. The 47 clinical manifestations included:

				TABLE	II.					
Erythema nodosum alone			in	3	Pleural effusion alone	***			in	- 6
Erythema nodosum and pr	imary comple	ex*	in	6	Glands in neck or abdomen	alone			in	- 2
Phlyctenular conjunc. and	primary com	plex	in	1	Miliary tuberculosis alone				in	1
Primary complex alone	*** ***	***	in	14	Pulmonary foci alone ("subj	primary	initial fo	ci ")	in	14
I immit complex mone	***	***		Total	47	,		/		

\* "Primary complex" implies either (radiological) enlargement of hilar shadows alone or with a pulmonary focus corresponding to the hilar enlargement.

Thus a primary complex was noted in only 21 of the 47 students and nurses, but it may be assumed that it was also present in the remainder though not big enough or in such a position as to show in a radiograph—as indeed must have been the case in the 104 students and nurses who became tuberculin-positive without associated symptoms or signs.

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All the patients with erythema nodosum were women; later one developed a pleural effusion and 3 bronchogenic tuberculosis, of whom one was given an artificial pneumothorax and another developed peritonitis and died.

Of the 21 students and nurses with a primary complex, 13 showed typical pulmonary and hilar components. In 7, only hilar enlargement was seen. Among the 21 patients with a primary complex, 5 later developed a pleural effusion and 4 bronchogenic tuberculosis; the average interval between the appearance of the primary complex and the pleural effusion was six months, and the average interval between the primary complex and bronchogenic tuberculosis was twelve months. The bronchogenic tuberculosis developed as a fresh focus or foci in the apex or upper zone, and not from the foci of the primary complex.

The average time between primary complex and pleural effusion was six months; between the finding of a negative tuberculin test and a pleural effusion it was ten months; one may therefore justifiably assume that even in the students and nurses with a pleural effusion *ab initio* a primary complex had previously been present, and that the pleural effusion did not represent the first tuberculous lesion.

Of special interest are the 14 young people in whom foci were seen in the upper part of the lung without a preceding primary complex. These foci were always seen in the apex or upper zone and were uni- or bilateral. On an average they were noted fourteen months after the last finding of a negative reaction, and on an average twelve and a half Note that in addition such foci were observed in months after a normal radiogram. 5 people after erythema nodosum or a primary complex, the average interval being eleven and a half months. It may therefore again be assumed that these foci did not represent the primary lesion, and that they arose a short time after the development of a primary complex which had remained unrecognized. Their origin is most likely hæmatogenous. That these foci represent the initial lesion of a bronchogenic tuberculosis may be seen from the follow-up of the 19 students and nurses with such foci. One died of the disease, another 6 later required pneumothorax treatment (bilateral in 2 cases), in another progression occurred followed by quiescence. Malmros and Hedvall called subprimary initial foci", but there seems no reason for separating them from bronchogenic tuberculosis, and indeed similar foci developed among students and nurses who when first seen were tuberculin-positive.

The symptoms associated with the radiological findings in the 47 people were: In those exhibiting crythema nodosum with or without primary complex, fever, cough, and pain in the side; the sedimentation rate was nearly always raised. When a primary complex alone was seen, there was generally fever, cough, fatigue, pain in the chest, catarrhal symptoms, and a raised sedimentation rate; nevertheless, 4 of them remained quite well and showed a normal sedimentation rate although in 2 there was much hilar enlargement. On the other hand, the onset of the subprimary initial foci were usually associated with no symptoms and a normal sedimentation rate. When symptoms did occur they were "flu", cough, fatigue, fever and hæmoptyses. In most of the students and nurses the lesions were detected only as the result of systematic

Similar clinical pictures are obtained in this country. Before, however, presenting my own cases I should like to mention American workers who claim different findings. Some of these studies are not as reliable as that of Malmros and Hedvall because often the tuberculin tests were carried out at too long intervals, often only screening was the routine radiological procedure, or no film was taken before the tuberculin test became positive. But it must be admitted that even allowing for these facts, the clinical manifestations in America might differ from those in other countries. Israel, Hetherington and Ord (1941) from Philadelphia, in their follow-up of 1,643 student nurses found that among those tuberculin-negative, 48% became positive at the end of four months, and 86% at the end of the year; they report that there were only slight differences between those originally tuberculin-negative and those tuberculin-positive, in regard to incidence, anatomical character and distribution of the lesions, as determined by fluoroscopy; the subsequent clinical course, too, showed no difference. This may well be because many of the recently primarily infected nurses had developed a bronchogenic lesion within a relatively short period of the primary infection. Israel and his co-workers state that no serious illness and no deaths occurred among the nurses, but this good outcome is put down at least in part to prompt treatment. They note that the development of a positive tuberculin reaction was associated with a high incidence of non-specific gastro-intestinal, febrile, and vague toxic illness, and with an especially high frequency of abdominal symptoms simulating appendicitis. The findings of Israel and his co-workers contrast sharply with those in Denmark, where Holm (1940) found that of 1,500 medical students who were followed up for three years, none broke down with tuberculosis during the three

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years among the 1,000 positive reactors, while among the 500 negative reactors, of whom 81 became tuberculin-positive, 19 developed active pulmonary tuberculosis and 3 died.

In contrast to Israel and his co-workers, Myers and his colleagues (1937) classify manifestations following a change in tuberculin reaction amongst a large number of students and nurses into four groups: (1) Erythema nodosum occurred in 2 male medical students; (2) 21 students and nurses developed a "primary" focus in the lung. Myers and his co-workers admit that in some of these it was impossible to determine with certainty that the shadow represented only the first infection type of tuberculosis because the uberculin test was not always done with sufficient frequency; (3) 18 students and nurses developed a pleural effusion; a "primary parenchymal lesion" was previously demonstrated by X-ray in some but not in others; (4) in 25 students and nurses a change of tuberculin reaction was followed by clinical pulmonary tuberculosis later, with or without a demonstrable primary focus or pleural effusion in the interval. The authors state that in the majority of these patients sufficient time had elapsed between the finding of a positive reaction and the development of a lesion to assume with a reasonable degree of certainty that the lesion was of the reinfection type.

The findings of Myers and his co-workers do not really differ greatly from those of Malmros and Hedvall, and hardly fit the suggestion put forward by Israel and Long (1941) that while in Scandinavian countries people being less naturally resistant react to a primary infection like children, North Americans being more resistant react not by forming a primary complex but by developing a lesion corresponding to the first focus of bronchogenic tuberculosis. I feel that these authors have tended to disregard morbid anatomical evidence, and have been influenced by the experimental work of Lurie (1941) on resistant and susceptible rabbit families obtained by inter-breeding to a degree quite

unknown among civilized races.

Here is a summary of my own cases. I am not able to give the crucial proof of primary tuberculosis since in dispensary practice it is rarely possible to carry out periodic tuberculin testing of adolescents and adults, but in the light of published work and taking into account all the circumstances, I have felt justified in applying in each case the diagnosis of primary tuberculosis.

Name	Age	Contac	t Symptoms	X-ray	S.R.	
*(1) E.B.	16	No	Cough, lost weight	Left hilum +	27	Lt. pleural effusion 10 weeks later, then to sanatorium
(2) M.H.	16	No	Eryth. nodosum	Not known, but 1 year later, calcified primary complex on rt.	3	Rt. pleural effusion 2 months later, then to sanatorium
*(3) J.I.N.	16	Yes	None	Lower pole of rt. hilum +, and focus in field near it (radio- graph neg. 3 months before)	4	To sanatorium
*(4) E.C.	17	No	Eryth. nodosum, 6 weeks later cough	Lt. hilum +; 1 yr. later, cal- fication in lateral radiograph, where previously dense shadow	12	To sanatorium
*(5) Ell.C.	17	No	Eryth. nodosum, pyrexia	Rt. hilum +, focus in rt. lower	3	6 months later, right pleural effusion, then to sanatorium
(6) D.R.	17	No	Eryth. nodosum	N.a.d. (Patch tuberculin test neg., but + when tested 1 mth. later)	2	Under observation
*(7) J.E.	18	Yes	Sore throat	Rt. hilum +, focus in lower zone (5 months later, not visible)	8	To sanatorium
(8) D.W.	18	Yes	None	Upper pole of rt. hilum + and mottling near it; 6 months later, calcification in this area	2	To sanatorium
*(9) D.C.	10	No	" Flu," sputum	Focus below rt. clavicle; 9 months later, calcification	18	To sanatorium
*(10) M.H.	21	No	Nausea, weakness, cough	Both hila + (Gastric contents + for tubercle bacilli)	14	Refused sanatorium
*(11) M.W.	21	Yes	Fatigue, later hæmoptysis, pyrexia	Rt. hilum +, focus 4th inter- space	22	To sanatorium
*(12) C.H.	24	No	Eryth. nodosum, abdom. pain	Both hila +	3	To sanatorium

	Name	Age	Contac	t Symptoms	X-ray	S.R.	Course
(1)	M.D.	16	No	Pain in chest, gid- diness; later, cough	Rt. hilum + 9 weeks after on- set; apparently not + 5 weeks before	3	both upper zones with cavity left apex; T.B. +
(2)	I.G.	16	No	Fatigue	Rt. hilum +, focus right lower zone	5	Kept under observation
*(3)	P.L.	16	Yes	" Flu "	mid-zone		Sanat.: at bronchoscopy, tub. vegetations in left main bronchus
*(4)	D.M.	16	No	" Flu"	Rt. hilum +, mottling in rt. lower zone	8	Sanat.: at bronchoscopy, tub. vegetations in right main bronchus

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#### TABLE IV .- MALES (contd.).

	Name	Age	Contac	Symptoms	X-ray	S.R.	Course
*(5)	E.P.	16	No	Malaise, pyrexia	Rt. tracheobronchial glands +, and lt. hilum +	3	Lt. pleural effusion 6 weeks later; bilateral apical cavity 17 months later
*(6)	H.C.H.	17	No	Eryth. nodosum	Both hila +, mottling near rt.	5	Refused to attend again
*(7)	D.H.	23	Yes	" Cold "	Both hila +; normal 2 months later; calcification appeared upper pole of rt. hilum 2 vrs. later	2	Sanat.: at bronchoscopy, an- terior wall of it. bronchus showed pressure
(8)	F.P.	24	No	Eryth. nodosum	?	5	3 months later, rt. pleural

[Radiograms (slides) of the cases marked with an asterisk (\*) in Tables III and IV were then demonstrated.]

#### TABLE V.-SUMMARY OF 20 CASES (TABLES III AND IV).

Contact established in 6 only.

Main initial symptom: erythema nodosum in 7. Fatigue in 3. "Flu" in 3. Cough in 1. Sore throat in 1.

"Cold" in 1. Malaise and pyrexia in 1. Pain in chest and giddiness in 1. None in 2 (contacts).

Other symptom: staining or harmoptysis in 2. Abdominal pain in 1.

Sedimentation rate raised in 8 (out of 12 only).

X-ray: enlarged hilar shadow alone in 7. Enlarged hilar shadow and parenchymatous focus in 9. Parenchymatous focus alone in 1. No changes in 1. Not known in 2.

#### EPIDEMIOLOGICAL IMPLICATIONS

We must agree that a large proportion of children do not become infected with tuberculosis, a proportion that is, or at all events before the war was, increasing; and that therefore more and more people are first infected as adolescents or adults. infection occurring at any age weeds out the most susceptible people who die from the primary infection or its sequelæ. In times when primary infection occurs in childhood, adolescents and adults who have overcome this infection represent a more resistant group, and may develop bronchogenic tuberculosis following fresh contact or endogenous exacerbation when resistance is low. But when primary infection increasingly occurs in adolescence and adult life, more and more susceptibles are first infected at this age, and we may therefore expect more and more adults to die of disseminated forms. Those more resistant, on the other hand, are in the same position as adults surviving primary infection in childhood, since bronchogenic tuberculosis may follow soon after primary infection. To what extent do these facts account for the comparatively low tuberculosis mortality of older children? Contact in the home may play a predominant role in early childhood, whereas contact outside the home is not likely to be of great importance until adolescence is reached following the beginning of employment and just at the time when great demands are made on bodily resistance. These facts might also account at least in part for the retardation in the drop of mortality among young women noted since 1900. For the fall in the general tuberculosis mortality and morbidity would have the effect of reducing infection and mortality in childhood at the expense of exposing an increasing proportion of susceptible young adults to primary infection. This effect is likely to be more marked in young women because firstly, the incidence of infection among females is generally lower than among males of the same age, presumably because they are kept more indoors, and secondly, because since 1900 young women have increasingly entered industrial employment. The recent appreciable increase in deaths from tuberculous meningitis among adolescents and young adults supports

Discussions on endogenous and exogenous reinfections are largely academic. when there are many uninfected adolescents, and when bronchogenic tuberculosis may follow soon after the primary infection, exogenous infection as a cause of bronchogenic tuberculosis plays an essential role. Thus both contact and lowered resistance are important in the control of the disease. We must, therefore, continue to stress the importance of reducing the human tubercle bacilli reservoir not only in homes but in crowded communities by the detection of symptomless disease through mass radiography, of adequate and immediate facilities for treatment, and of the provision of institutional accommodation for bad and good chronic cases.

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Dr. W. Pagel: Tubercle hacilli infecting the human body for the first time produce.

Dr. W. Pagel: Tubercle bacilli infecting the human body for the first time produce characteristic changes at the site of entry, the primary focus. This is soon followed by a similar lesion in the corresponding lymph glands. The primary focus at the portal of entry together with the glandular changes is called the "primary complex". It is commonly observed in the lungs or in the digestive tract of children dying of generalized tuberculosis. The common type of adult pulmonary tuberculosis (to be referred to in future as "bronchogenic tuberculosis") is a post-primary condition, distinct from the primary complex and its early sequelæ. In bronchogenic tuberculosis the hilar glands are devoid of caseous changes, and the primary complex is usually found in an inactive calcified or ossified state.

An inactive primary complex is found in a large proportion of healthy individuals Of late, however, the incidence of tuberculous infection in the general population has undergone a remarkable change: only 20% (as against 60% before) show evidence of primary infection up to the age of 18, while high figures up to 100% are only reached in the highest age-groups (Uehlinger and Blangey, 1937). It is therefore to be expected that a larger proportion of adults than before should show evidence of

fresh primary infection.

It has been said that the primary complex is essentially characteristic of the first infection in childhood and that when such an infection occurs in adult life only the primary focus develops, the lymph glands being unaffected. This was explained by the assumption that the lymphatic glands of adults possess a high resistance to infection. When, as rarely happened, a fully developed primary complex was seen in adults, it was supposed that a first infection had occurred in individuals with little or no natural In other words formation of the primary complex is said to depend on age and natural resistance and not upon the fact of first infection alone. This theory is based on experiments made by Lurie (1938) who succeeded in breeding strains of rabbits with high inborn resistance to tuberculosis. Primary infection by inhalation was followed, in these rabbits, by the formation of a primary lesion in the lung but not by a primary complex. The primary lung focus developed at once into a cavity with subsequent bronchogenic spread restricted to the lungs. In other words, bronchogenic tuberculosis was reproduced by a primary infection occurring in animals with high natural resistance to tuberculosis.

In considering primary tuberculosis in adults from the pathological side, the following

questions arise:

(1) Can pathological evidence be adduced for the occurrence of primary tuberculosis in the adult? (2) What are its characteristic features? (3) How often does it occur? (4) Are its characteristics due to the fact that it is the first manifestation of tuberculosis in the individual or is there evidence of an influence of age or natural resistance?

(1) Occurrence of Primary Infection in Adults. Personal Observations in Necropsies (1938-1942)

Case I (Hounslow Chest Glinic).—Boy, aged 16, exposed to home contact. Developed a transient infiltration in the right upper lobe, followed by enlargement of the hilar glands. Death from toxemia. Necropsy: Large caseous infiltration near the base of the right lower lobe. Extensive caseation and partial hæmorrhagic liquefaction of the lymph glands at the right hilum.

Case II (figs. 1, 2, 3). (Central Middlesex County Hospital, P.M. 42/27).—Male, aged 17. No history of contact. Admitted for typical tuberculous meningitis. Skiagram of chest showed enlargement of the left hilum and a small doubtful area in the left infraclavicular region. Post-mortem: Shallow, longitudinal ulcer  $3 \times 2$  cm. at the posterior wall of the bulbus duodeni. Gross enlargement and complete caseation of the peri-

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portal, peri-pancreatic and retro-duodenal lymph glands. Other parts of the intestine and mesenteric lymph glands free. Lungs: 2 cm. below the apex of the left lung a subpleural quadrangular caseous and partly liquefied focus, 1.5 cm. in diameter. Hilar lymph glands enlarged on the left side but containing small caseous specks on both sides, these being very marked in the lower intrapulmonary posterior mediastinal glands on the right side. Right lung free of tuberculous changes. Smears from retroduodenal lymph glands show large numbers of short acid-fast bacilli. Typing of the bacillary strain by animal inoculation is still in progress. Exudative tuberculous meningitis.

on the ngm side. Right lung free of tuberculous changes. Smears from retroduodenal lymph glands show large numbers of short acid-fast bacilli. Typing of the bacillary strain by animal inoculation is still in progress. Exudative tuberculous meningitis.

The compact caseation of the duodenal (portal) lymph glands suggests the duodenum as the entrance site of the real primary complex. Caseation of the mediastinal lymph glands was less intense than that of the upper abdominal glands and could be interpreted as an extension of the abdominal glandular changes, the focus in the left upper lobe being due to an independent blood-borne spread. This interpretation would be certain if we could succeed in recovering a bovine strain of tubercle bacilli. The shape of the bacilli seen makes bovine infection likely. The possibility of a double primary infection—pulmonary and intestinal—cannot however be excluded.

Case III (C.M.C.H., P.M. 40/313).—Female, aged 18. No family history of tuberculosis. Admitted with typical tuberculous meningitis. Lungs: Round caseous focus 1 cm. in diameter, about 1 cm. below the pleura, in the infraclavicular parts of the right upper lobe. Similar focus, 1 cm. in diameter, in one right upper intrapulmonary gland. Exudative tuberculous basal meningitis.

Case IV.—Male, aged 18. Clinical picture was that of a classical tabes mesenterica. Post-mortem: Extensive ulcerative tuberculosis of the ileocrecal region with compact caseation of the mesenteric lymph glands. A bovine strain of Mycobact. tuberc, recovered from the mesenteric glands.

Case V.—Male, aged 19. Necropsy: Fresh genito-urinary and basal meningeal tuberculosis. Soft caseous focus in the right upper lobe subpleural and infraclavicular. Right tracheobronchial lymph glands with extensive soft caseation.

Case VI (Clare Hall).—Female, aged 19. Bronchogenic-tuberculosis. Death from intestinal tuberculosis. Plum-sized cavity with caseous wall in the mid-zone of the left upper lobe. Extensive lobular caseous spread (bronchogenic) in the right lower lobe. Encapsulated caseous focus the size of a large pea in the lower parts of the right upper lobe near the interlobar fissure. In right upper intrapulmonary glands two caseous foci, the size of a small lentil, one pin-point. Other hilar glands free.

Case VII (fig. 4) (C. M. C. H. P. M. 41/201).—Male, aged 20. Death from ulcerative colitis. (No evidence of tuberculous actiology). In the left upper lobe 2 cm. below the apex a subpleural encapsulated focus  $3\times 2$  cm. with pleural adhesion. Hilar glands small and free with the exception of an intrapulmonary gland regional to the focus. This gland contains a small caseous nodule 0.5 cm. in diameter.

Case VIII (fig. 5) (C. M. C. H. P. M. 42/38).—Female, aged 20. For seven years diabetes. Now ill for some months with tuberculosis. Post-mortem: Large, thin-walled cavity, ill-defined, in the left mid-zone. Extensive caseous spread throughout both lungs (bronchogenic aspiration). In a few intrapulmonary lymph glands near the large cavity in the left mid-zone, a few caseous deposits, each about 0.3 cm. in diameter. Other hilar glands free.

Case IX (fig. 6, fig. 7, A and B). (Clare Hall).—Male, aged 24. A younger brother suffered from psoas abscess five years ago. Death from tuberculous meningitis. Encapsulated, round caseous focus near the left base, 1 cm. in diameter. Extensive caseation of the hilar glands, especially on the left side and regional to the left base. Miliary tuberculosis.

Case X (fig. 8). (Clare Hall).—Labourer. No known contact. Left pleural and pericardial effusion and ascites. Animal inoculation with pericardial fluid positive. Death from tuberculous meningitis. Post-mortem: Large wedge-shaped, caseous focus at the right base, 4×3 cm. Caseous deposit 0.5 cm. in diameter in a lateral hilar gland of the right lower lobe. Tuberculous meningitis and pericarditis.

Case XI (Clare Hall).—Female, aged 30. No evidence of contact. Following abortion, miliary tuberculosis and meningitis. Caseous salpingitis. A pea-sized fresh caseous focus about 1.0 cm. in diameter, with thin capsule in the marginal parts of the left lower lobe about 1 cm. below the pleura. Caseous deposit about 1 cm. in diameter in the left bifurcation gland. Miliary tuberculosis, especially in the lungs. Tuberculous meningitis.

Case XII.—Male, aged 33. Three months before death: abdominal pain, fever, dyspnæa. Diarrhæa. Death from tuberculous meningitis. Post-mortem: Single ulcer of ileo-cæcal region with large caseous ileo-cæcal lymph gland. Urogenital tuberculosis. Disseminated fibrosing nodules in groups in both upper lobes. Exudative tuberculous meningitis.

Case XIII (C.M.C.H., P. M. 41/154).—Female, aged 40. Rheumatic fever twenty-two years ago. Obliteration of pericardial sac. Death from congestive cardiac failure. In the left lower lobe, a well-defined quadrangular subpleural caseous focus,  $2 \times 1$  cm. Confluent caseation of the right intrapulmonary and bifurcation glands. Scattered tuber-culous nodules in spleen, liver and lungs.

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(2) Anatomical Diagnosis of Adult Primary Tuberculosis. Differentiation from Reinfection All these observations have one feature in common: in the lungs or in the intestinal canal there is a caseous (or ulcerative) focus with similar changes in the corresponding lymph glands; in other words, a fresh primary complex. In all cases this is clearly marked out from other tuberculous lesions (if present). Careful dissection and screening of the lungs have shown that no traces of infection older than the primary complex described above were present.

True reinfection, i.e. the establishment of a lesion with all anatomical characters of the primary complex, in an instance in which the calcified or ossified residues of a previous primary infection were found, has been recorded. I have seen this in my own material in two instances only, and I think that it is not frequent enough to discredit the current anatomical view of primary infection, i.e. that this occurs as a rule only once in life. It does justify, however, a careful search for traces of an older, i.e. the true primary lesion,

especially when a fresh primary complex is found in adults.

#### (3) Anatomical Features of Adult Primary Tuberculosis in Detail

In the present examples no calcification was seen and thereby the fact that in each case we were dealing with a recent, primary infection in adult life was established. Out of 13 cases, 3 were intestinal and 10 pulmonary infections, which is approximately the same distribution as in children. In anatomical detail, the changes in most cases resembled those observed in childhood. The primary focus was found in the lower parts of the lungs, usually near the base and not far from the pleura.

In one respect a difference was found. In children, the primary focus is, as a rule, smaller than the changes in the lymph glands. In the present series of adults this ratio was reversed in four out of eight cases of pulmonary infection, and in one instance primary and glandular foci were about equal in size and very small. It may be assumed, therefore, that in adults an enlargement of the hilar glands need not be conspicuous either in the anatomical specimen or in the skiagram. It must be emphasized, however, that the lymph gland corresponding to the primary focus does show changes which are identical in quality with the latter. In spite of the comparatively small size of the glandular changes, the classical picture of the primary complex does appear in adults just as in children. In many adults the glandular changes were extensive and in no way less than those observed in children.

Age.—The present series includes persons up to the age of 40. Anders observed three instances in persons over 40, one was 79. Out of 16 cases reported by Terplan, 11 were over 40, one was 80. In all cases typical primary complexes were observed.

#### (4) Frequency and Influence of Age and Resistance

Up to 1931, cases of primary infection in adults were described as pathological curiosities. Then 36 observations made by Anders were described by Ragnotti. More recently Terplan (1940) has given an account of 23 cases, i.e. about 7% of 286 adults. This figure is much higher than those given ten and fifteen years ago, when about 0·1·0·5% were reached (Schürmann, 1926; Ragnotti, 1931). The 13 cases of my own material were

### THIRTEEN PERSONAL OBSERVATIONS OF PRIMARY TUBERCULOSIS IN ADULTS AND ADOLESCENTS.

			ite of ry Complex	Size of Gland	Posteriore	Course of	
No.	Age	Pulmonary	Intestinal	relative to prim. focus	Post-primary tuberculosis	Cause of death	
1	15	R. lower	-	Larger	_	Toxaemia	
2	17	_	Duodenum	Larger	Round focus in lt. upper lobe. Meningitis	Tub. mening.	
3	18	R. upper	_	Equal	Meningitis	Tub. mening.	
4	18	arr myper	Small intestine	Larger	_	Tabes mes.	
5	19	R. upper	_	Larger	Urogenital tub. Meningitis	Tub. mening.	
6	19	R. upper	_	Smaller	Bronchogenic tub.	Bronchogenic tub.	
7	20	L. upper	_	Smaller		Ulcerat. colitis	
5 6 7 8	20	L. mid-zone		Smaller	Bronchogenic tub.	Bronchogenic tub. diabetes	
9	24	L. base	_	Larger	Miliary tub. Mening.	Tub. mening.	
10	29	R. base	_	Smaller	Tub. polyserosit. Tub. mening.	Tub. mening.	
11	30	L. lower	_	Equal	Genital tub. Mening.	Tub. mening.	
12	33		Ileocæcal	Larger	Urogenital tub. Discrete mi- liary spread in lung. Mening.	Tub. mening.	
13	40	L. lower	_	Larger	Negligible spread	Cardiac failure	

observed during the last four years. Previously I had no such pure instances, only cases occurring in puberty in which a large primary infection was quickly followed by bronchogenic tuberculosis. I can, therefore, confirm the impression that primary tuberculosis in adults is nowadays more common than before.

The characteristic feature of primary tuberculous infection, namely, the involvement of the corresponding glands, appears in children as well as in adults with such regularity that it is obviously due to the absence of previous infection and not to age and resistance. Influence of age on the extent of the lesion, however, is not unlikely, in that the glandular part of the primary complex may be smaller in adults than in children. It is difficult to give an anatomical reason for this. I have examined histologically hilar lymph glands from 30 non-tuberculous individuals between the ages of 3 and 50. I have found no essential structural differences (such as an increase in fibrous tissue due to collection of dust or residues of inflammatory changes) which could account for an ageresistance of the lymph glands to tuberculous infection. Primary tuberculous changes in the hilar glands of adults may involve areas much larger than those in many children. Finally, in adult consumptives in which the hilar glands are, as a rule, devoid of caseation, tubercle bacilli may be found in considerable numbers in the sinuses without more than trivial changes. This militates against the theory that the lymph glands of adults do not allow of as easy a penetration of the bacilli as do the glands of children.

It has been inferred that generalization of tuberculosis subsequent to primary infection indicates low natural resistance of the individual to tuberculosis whereas this is higher in bronchogenic tuberculosis, since this is restricted to one organ, the lungs. The highest degree of natural resistance, however, would appear to be in those in whom the primary complex remains the only manifestation of tuberculosis. Judged by these standards the influence of natural resistance on the occurrence and anatomical features of primary tuberculosis in adults is negligible. Among Anders' 36 instances were no less than 14, among the 23 cases observed by Terplan no less than 16 accidental findings, in other words, they were found in persons with the highest degree of natural resistance. In the present series 3 out of 13 belonged to this group and 2 were cases of bronchogenic tuberculosis. In the latter, bronchogenic tuberculosis seemed to follow quickly on primary infection in adult life, This is different from the long interval between primary infection and bronchogenic tuberculosis which we deduce from the observation of a calcified or ossified primary lesion in about 70-92% of the necropsies in bronchogenic tuberculosis (Pagel, 1930). The unusually short interval between primary infection and bronchogenic tuberculosis may be a feature associated with late primary infection. It might explain the frequency of contact found in early cases of bronchogenic tuberculosis in young adults. Evidence of contact has been taken as proof of "exogenous reinfection" (Opie and McPhedran, 1935) leading to bronchogenic tuberculosis. Contact, however, could have caused, in these cases, a late primary complex with quickly ensuing bronchogenic tuberculosis due to "endogenous" spread.

Tuberculosis, therefore, obeys the laws of primary infection, irrespective of age and natural resistance. Primary and glandular foci develop in children as well as in adults, in persons with low, as well as with high, natural resistance. Clinical inferences against the occurrence of the primary complex in certain adults are based on radiological evidence only and find no support in the anatomical observations.

#### SUMMARY AND CONCLUSIONS

(1) The anatomical basis of primary tuberculosis in adults has been illustrated by thirteen personal observations in persons aged 15-40 years. (2) In all cases, infection obeyed the law of the primary complex. In some instances the changes in the corresponding lymph glands were smaller than the primary focus in the lung. (3) Anatomical evidence suggests a greater frequency of primary infection in adult life in recent years.

(4) A fresh tuberculous primary complex occurs in adult persons associated with postprimary (disseminated and bronchogenic) as well as without post-primary tuberculosis. . The primary complex develops, therefore, in adult life independent of age and natural resistance.

The author wishes to acknowledge his indebtedness to F. A. H. Simmonds, M.D. (Clare Hall County Sanatorium, Middlesex), and to Mr. H. Pegler (for technical assistance).

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Fig. 1 (Case II).—? Primary tuberculous ulcer in the duodenum.

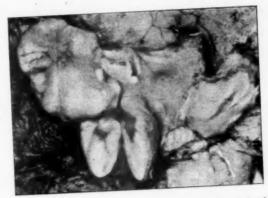


Fig. 2 (Case 11).—Compact caseation of enlarged retro-duodenal lymph glands.



Fig. 3 (Case II).—Infra-clavicular caseous focus in left lung with enlarged and partly caseous hilar lymph glands.



FIG. 4 (Case VII).—Left upper lobe with primary caseous focus below the apex (arrow) and smaller caseous deposit in lymph gland (arrow).

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Fig. 5 (Case VIII).—Extensive caseous destruction of both lungs (bronchogenic tuberculosis). Primary cavity left middle zone (not shown). Small caseous deposits in three intrapulmonary lymph glands.

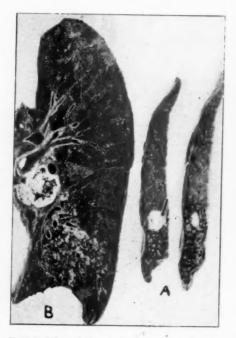


Fig. 7 (Case 1X).—Left lung. A. Small primary focus in the dorsal parts near the left base. B. Larger caseous hilar lymph gland and survey of ventral parts of the left lung.

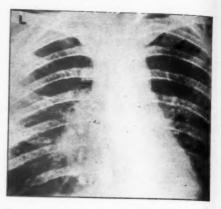


Fig. 6 (Case IX).—Skiagram of chest. En-largement of left hilum.



FIG. 8 (Case X).—Wedge-shaped, primary focus near right base (arrow). Small caseous deposit in lymph gland (arrow).

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### Section of Medicine

President-Geoffrey Marshall, O.B.E., M.D.

[May 5, 1942]

## DISCUSSION ON THE WORKMEN'S COMPENSATION ACT AS A FACTOR IN PROLONGING INVALIDISM

Dr. Bernard Hart: In the B.M.A. "Report of Committee on Fractures" (1935) the statement is made that: "The Workmen's Compensation Acts, although designed to protect the workman, have in many cases played a prominent part in prolonging his disability, in delaying his return to work, and, on occasion, in converting him into a permanent invalid". It is our task at this Discussion to consider how far such a statement is justified. I shall define "invalidism" as a condition due to psychological factors which has become superimposed, either on a pre-existing organic disability, or on a pre-existing neurosis. I am not concerned with prolongation of a disability by physical factors, e.g. deficient diet, though such factors are of undoubted importance and may be closely connected with the administration of the Acts.

In so far as the Workmen's Compensation Acts are responsible for invalidism, such effect must be due in the main to the intervention of psychological factors. Russell Brain (1942), who has recently investigated two groups of head-injury cases, one due to road accidents and the other to industrial accidents, found that the incidence of neurosis in the second group was much higher than in the former. This clearly indicates that other factors than the injury itself are concerned, and it may be inferred that these must be factors of a psychological order. No doubt psychological factors are operative in both groups of cases, but the explanation of their differential action in the two groups must be sought in a comparison of the procedures of the Workmen's Compensation Acts with those affecting road accident compensation.

We shall begin, therefore, by considering the various psychogenic processes which may play a part in the production of invalidism, examining in each case the extent to which it may be called into action by the circumstances of the Workmen's Compensation Acts. The first of these underlies the notion of "compensation neurosis", but is in fact much wider in its significance than a mere relation to monetary compensation. It is perhaps best described as "purpose" or "motive", and purpose, whether conscious, semi-conscious, or unconscious, plays a very important part in the production of neurosis. It would be unreasonable to ask for what object a patient suffering from scarlet fever has acquired that illness, but it is not unreasonable to ask it in many cases of neurosis. A glimmering of the notion of "purpose" as a factor in neurosis arose in the days of "railway spine", but the clearest evidence of its functioning is to be found in the psychoneuroses of the last war, absurdly misnamed "shell-shock".

A simple example from everyday life will serve to indicate the nature of the mechanism involved. Suppose that I am standing in the middle of the road and a motor bus bears down on me. The self-preservation instinct, which is allowed free-play here, will ensure that I step out of the way on to the pavement. Suppose, however, that I am standing on the pavement and a small child is playing in the road, right in the path of the oncoming bus, two factors will then come into action, the self-preservation instinct which would keep me out of danger on the pavement, and what we will call "duty" which will drive me on to the road to rescue the child. Here there is a conflict between two diametrically

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opposed forces. Now consider the soldier in the trenches, and it will be seen that he is subjected constantly to a conflict of this kind. Self-preservation instinct, if allowed free play, would cause a prompt removal from the post of danger; "duty" constrains him to remain where he is. The training of the soldier is designed to deal with this conflict by so enhancing the strength of the duty-discipline factors that the self-preservation instinct has no chance against them. So long as this relation holds, all is well, but if for any reason the duty-discipline factors become weakened, or the self-preservation factors enhanced, then the conflict becomes acute. Now an acute conflict cannot be borne indefinitely; some solution has to occur, and it must be understood that "solution" means satisfying both the opposing factors, not surrendering to one of them. There are three possible solutions. The first is the advent of a serious wound. This provides a perfect solution of the conflict, because both self-preservation and duty are satisfied, the man going down the line preserving both himself and his self-respect. The second solution is being taken prisoner, which similarly satisfies both the opponents. But there is a third solution, the development of a psychoneurosis, let us say a hysterical paralysis. This equally satisfies both the opponents, the man being removed to safety, but preserving his self-respect because, as he believes, he has a disability similar to that of his comrade who has been shot through the spine. There is a fundamental difference, however, between this third solution and the other two. Those two arose from external causes, the third is brought about by internal causes, causes of a psychological order. The fact that wound or capture will solve the conflict is not a cause of the wound or capture, but only a happy coincidence. But the fact that a psychoneurosis will solve the conflict is an actual cause of the production of the psychoneurosis. Here, therefore, "purpose" appears as a fundamental factor in the causation of disorder. Its existence explains the familiar observation that it is rare for a seriously wounded man to show psychoneurotic symptoms. If a man is seriously wounded, it may be said from this point of view that there is no need for him to have a neurosis. The conflict, if it existed, has been solved very effectually without such aid. The existence or absence of "purpose" also provides at any rate one explanation of the remarkable fact that in the last war there were an immense number of psychoneurotic casualties in the Army, whereas in the present war

similar casualties amongst civilians subjected to severe blitzes are rare.

The action of "purpose" in these cases was not "conscious" in the full sense of that word. It has been maintained that, as the man was perfectly aware of the fact that he would like to be out of the fight, the part played by this desire would necessarily be fully conscious. This is a misunderstanding of the actual situation. The man is aware of the desire, but he is not aware of the machinery by which it produces the neurosis. If he were so aware the machinery set in action would be that of malingering and not of neurosis. "Purpose" in this connexion may therefore properly be called "unconscious motive", and that term is in fact the one generally employed.

Later in the history of a psychoneurotic patient of the last war "purpose" often shifted from self-preservation to pension, but by that time many other complicating factors had come into action. The failure to realize this, and the assumption that the condition was then simply a purposive compensation-neurosis, led to many mistakes in handling, for example the payment of a lump-sum compensation instead of a continued pension in the hope that the removal of the end to which the purpose was thought to be directed would produce prompt recovery. The experience of the Ministry of Pensions decisively contradicted 'his view, a fact to be borne in mind when we are considering the application of similar methods in dealing with Workmen's Compensation cases. Indeed the payment of lump-sum compensation as a weapon of recovery is largely discredited by those in a position to observe the subsequent history of the cases concerned, and in many countries it is absolutely prohibited (Wilson and Levy, 1939).

With a Compensation Act in force, "purpose" as a factor working in the direction of compensation is likely to play a part, and its action in prolonging disability certainly cannot be neglected, but we must not assign to it too large a part. In the war cases the neurosis arose as a compromise between self-preservation in a situation of extreme danger and the factors we have termed "Duty and Discipline". These are forces of great potency, but where can we find their equivalent in the neurosis of the injured workman? Surely not in a drive to obtain a weekly payment of less than half his former income, at the price of indefinite unemployment and idleness, a price which no workman unless he is in other respects pathological, is prepared to pay. It is clear, therefore, that other factors must be at least co-operating. When those other factors are examined it will be found, indeed, that "purpose" remains a predominating cause in the invalidism associated with the Workmen's Compensation Acts, but it is not a mere drive to monetary compensation.

The first of these other factors is "Preoccupation". It may be defined as consisting in

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fixation of attention upon a function of the body or mind plus apprehension or anxiety Fixation of attention in itself is not, of course, preoccupation. It only becomes so if the element of apprehension or anxiety is added. Preoccupation is a familiar factor in neurotic conditions, for example the functional dyspepsias, effort syndrome, and a host of similar disorders. There is, indeed, no function of the body or mind which may not be subjected to a preoccupation process, and hence become the focus of a neurosis

It will be obvious that a mechanism of this kind is easily capable of being set up in an injured workman, and there can be no doubt that it plays a part in a large number of the cases which travel along the neurotic road. The mere existence of an injury which in his ignorance is fraught with unknown and sinister possibilities, sets the stage for preoccupation to come into action. But another factor exerts its influence here in precipitating and maintaining the machinery of preoccupation, the factor of "Sugges-Preoccupation and suggestion are closely allied, but it may be said for our present purpose that preoccupation is a process which takes place wholly within, while suggestion is applied from an external source. Such suggestion is, however, a very potent engine in initiating and maintaining an internal preoccupation.

The atmosphere surrounding a workman who has recently sustained an injury is one which is capable of starting or accentuating preoccupation. Thus the ministrations of his own doctor, innocent in intent but often none the less malignant in result, may play an important part here. Visits to his lawyer or trade union official, with the constant accent on compensation and the need for obtaining security, add to the pathological suggestive Insurance companies, with their legal and medical advisers, necessarily regarded as hostile agents whose aim is to whittle down that security, do not, as is sometimes fondly hoped, exert an opposing suggestive effect, but merely serve to strengthen the suggestion proceeding from what may be called his own side. Relatives and friends help to carry on the bad work, and it is small wonder that, in the words of Sir John Collie, "by the time the trial is reached, he is commonly the victim, not so much of the accident, as of the numerous influences which have been brought to bear on him since it occurred" (Knocker, 1910).

Though all these sinister possibilities hover round the injured workman, yet only a small minority develop neurosis, while the great majority make an uninterrupted recovery. In the first place the influences I have depicted in somewhat highly coloured terms are not in fact applied to any notable extent in a large number of cases. Particularly is this true in minor injuries capable of rapid settlement and recovery, the incidence of neurosis naturally being higher in long-drawn-out cases, in which suggestive factors have a greater opportunity of influencing progress. In the second place, however, much depends on the man's psychological constitution and temperament, and the presence or absence of

prior neurotic trends. These are of great importance not only in conditioning the onset of a neurosis after an accident in which no organic injury was sustained, but also in influencing the growth of a neurotic superstructure upon a primary organic disability. The accident may, indeed, merely serve as a peg to which pre-existing neurosis, conflicts, and semiconscious or unconscious trends attach themselves. But as it cannot be denied that the accident does play some part in fashioning the final picture, attributability in the legal sense has to be accepted, and with it the benevolent or malignant results which attend the operations of the Workmen's Compensation Acts. Such cases, which lead to much unedifying wrangling amongst medical witnesses, have a complex causation which cannot be put into the simple and definite terms demanded by the legal mind, and they constitute an insoluble problem, so long as attention is concentrated solely on "attributability and "compensation". They provide strong support for the contention that reform of and "compensation". They provide strong support for the contention that reform of the Acts must move in the direction of taking away the accent on compensation, and must concentrate on the essential problem of how best to get back to normal activity and work a man who is temporarily disabled. Incidentally such reform would do away with the futile disputes between medical witnesses about a causation which is inevitably obscure and largely beyond our present knowledge accurately to assess.

The lawyers have invented a term "brooding", to indicate a mental state which debars a workman from a successful result to an application under the Workmen's Compensation Acts (Brend, 1938). I am unable to discover any medical meaning in this term, however satisfactory its legal definition may be. Unless it is assumed that a man broods" deliberately, and can stop doing so whenever he likes, a patent absurdity in neurosis cases, brooding is practically equivalent to preoccupation. In that sense it is a frequent and integral factor in accident-neuroses, but it is not a volitional process,

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and it is obviously an effect of the accident, however many other factors may co-operate in its production.

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I have mentioned the part which the injured man's anxiety about his position and future may play in setting the stage for the onset of preoccupation. But this does not exhaust the action of anxiety as a psychological factor in neurosis. Indirectly it may add to neurosis such undermining influences as insomnia, and directly it is a substantial factor in producing a purposive reaction in that much wider sense of "purpose" than mere drive to monetary compensation. A hint of this wider sense was mentioned before, and an attempt must now be made to explain more fully what is meant.

Man may be regarded as a psycho-physical organism whose function it is to adapt himself to the environment in which he lives, such adaptation being effected by a due co-ordination of internal drives and stresses with external conditions. From this point of view neurosis in general, which it must always be remembered is a disorder of the whole individual and not of a single system or organ, is an attempt at such adaptation. It is of course a bad and inadequate one, only to be obtained at the price of illness, but it does in fact provide some sort of adaptation to the internal and external stresses to which the patient is subjected. This adaptation aspect is very clear in the case of the soldier who breaks down in the trenches with a hysterical paraplegia, but it is to be found in a much wider field of neurosis than hysteria. Now the fact that an illness may provide an adaptation is only a fortuitous circumstance when the illness is determined by organic and external factors, but it is of prime importance when the illness is one determined by psychogenic factors, because the circumstance that it does provide an adaptation takes its place among the causal psychogenic factors. This is that wider sense of "purpose", far wider than mere compensation, which must be taken into account over almost the whole field of neurosis. Efficient therapy must aim at blocking the channels whereby "purpose" leads to that morbid adaptation which is neurosis, and at directing it into the channels which lead to efficient and adequate adaptation.

There are certain prophylactic factors which should come into operation from the date of injury, and exert their effect throughout the whole course of treatment. These are the factors which subserve the maintenance of bodily and mental efficiency, physical and mental exercise, the preservation of self-respect, and the constant nourishment of the "will to recover". As Jefferson, in a recent communication, has said: "From the first the patient must be made to realize that he is an active collaborator in his own treatment and that he must accept some responsibility in his progress towards a successful result" (Jefferson, 1942). Measures of this kind may well make all the difference between rapid recovery and needlessly prolonged invalidism.

If we review all these various psychological processes which may come into psychogenic action in the injured workman it will be obvious that equating accident-neurosis with compensation-neurosis is a gross misinterpretation of the actual situation. Compensation of course plays a part, and must always be reckoned with, but it is probably a very small part in early cases, although it may dominate the picture later on, when all those other factors I have mentioned come into operation. Owing to the structure and procedure of the Acts, indeed, it easily becomes the focus upon which all these co-operating factors finally converge. And it does so because the Acts are focused upon that one point of monetary compensation, and neglect altogether the really essential points of recovery and rehabilitation. The Acts have no provision for treatment, and for this the workman is thrown on his own resources with such aid as can be obtained from hospitals and the National Health Insurance. It is no wonder, therefore, that anxiety about family and future, constantly fed by the factors of suggestion and preoccupation described, ultimately converge into a drive for security, which is far more often the "purpose" or "unconscious motive" behind these neuroses than compensation in the narrower sense. Naturally, as monetary compensation is the only satisfaction of the desire for security which the Acts provide, this becomes the focus of the psychological factors. But it has become a symbol rather than an end in itself.

These considerations relate particularly to those cases which commence with an organic disability and progress to invalidism. They apply also to those cases of primary neurosis in which the initial injury is slight or altogether negligible, but in which this fact is not clearly and promptly understood by the patient. To him the injury may be of unknown magnitude, and a sinister threat to future security, and this fear, accentuated by the medical and legal procedures associated with the Acts, is a potent inducement to neurosis and invalidism. A practical lesson to be drawn here is the grave responsibility which falls in these early cases upon the patient's doctor. If he explains clearly to the patient the precise nature of the injury, vigorously reassures him about his baseless fear, and instils in him the conviction of speedy recovery, all should be well. If he fails

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to do these things, or implants instead, however inadvertently, contrary suggestions and fears, then he has ranged himself among the factors responsible for neurosis.

Many cases of neurosis following accidents in which physical injury is negligible or absent, are not primary neurosis, but cases of pre-existing neurosis in which the accident has simply provided a favourable opportunity for manifestation. In such cases the anxiety, preoccupation, and suggestions, associated with the accident of course help to colour the picture or to provide a superstructure to the original neurosis, and they require appropriate treatment. But they are not accident-neurosis in the proper sense, although they come equally under the Workmen's Compensation Acts, because from the legal standpoint the employer's liability is the same, whether the man before the accident was normal or neurotic, if the accident can be held to have made more manifest or worsened a pre-existing neurosis.

Having considered the foregoing arguments, we are now in a position to assess more accurately the common notion that the best method of preventing and curing accident neurosis is prompt settlement of the claim by a lump-sum payment.

The remedy for invalidism in accident cases is not to be found in any such simple panacea as this, but must be sought by a systematic attempt to combat all the factors which have been described. The action of preoccupation, suggestion, and anxiety, must all be taken into account, and above all the potent and ramifying effects of the drive for security, a much wider thing than monetary compensation, must be fully considered. It is immediately obvious that these factors cannot be satisfactorily combated, so long as the Acts remain as they are at present. The structure of the Acts may, indeed, not unfairly be described as carefully calculated to enhance each and every one of those factors. This country stands almost alone in its failure to incorporate in its accident legislation any provision for treatment and rehabilitation, obviously the most essential weapons for attacking the psychogenic factors underlying invalidism, and until this failure is remedied the problem of invalidism in these cases will remain with us.

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#### The Legal Position

His Honour Tom Eastham, K.C.: Compensation under the Workmen's Compensation Acts is payable where total or partial incapacity for work results from injury by accident arising out of and in the course of the workman's employment. The words in the Act are "incapacity for work". These words are not the same as "incapacity to work". They mean the loss or diminution of wage-earning capacity and they include inability to get work if that be the result of the accidental injury. Whether there is incapacity for work or not is a question of fact which has to be determined by the County Court Judge. He has to decide whether the incapacity has resulted or continues from the injury and the amount of such incapacity. These are questions of fact, and the burden of proof is upon the workman.

It is not necessary for the workman to show that the incapacity was the natural or probable consequence of the injury so long as it results from the injury. Upon such questions of fact the County Court Judge's findings one way or the other cannot be disturbed (apart from misdirection in law) if there be evidence upon which a reasonable man might come to the conclusion arrived at by the County Court Judge. In other words, the Court of Appeal has no power to interfere with a finding of fact of a County Court Judge if there is evidence to support it and the House of Lords has said: "It is of first importance that the finality of an arbitrator's finding of fact under the Workmen's Compensation Act should be jealously maintained." It is very important to remember that there is no appeal upon fact from a County Court Judge's decision in a Workmen's Compensation case that has been taken to the Court of Appeal or to the House of Lords. The Appeal Court is bound by the findings of fact; it cannot vary or reverse them if there was some

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evidence upon which they could be based, and the Appeal Court has to deal with the case on the basis that the findings of fact are conclusive. Even if the judges of the Appeal Court would have arrived at different findings of fact upon the evidence, they cannot reverse the findings of facts of the County Court Judge if there was any evidence upon which he could so find.

Having made these preliminary observations I shall now deal with incapacity for work from nervous effects or loss of will power. The best way of doing so is to give a summary of a number of these cases which have been before the Courts.<sup>1</sup>

Even when a workman has recovered from the physical or muscular mischief caused by the accident, he may still be incapacitated owing to a nervous or mental condition, and such incapacity may be the result of the physical injury. For instance, a condition known as "traumatic neurasthenia" frequently results from an injury: the workman may have entirely regained his former physical state and really be competent to work, but he genuinely, though mistakenly and unreasonably, believes that he is incapable of working. Such were the circumstances in EAVES v. BLAENCLYDACH COLLERY CO., LTD. (1909), where a workman sustained a muscular injury to his leg through an accident. He had entirely recovered from the muscular consequence of the injury, but suffered from traumatic neurasthenia and anæsthesia of the leg-as a consequence of the accident. It was held that his right to compensation did not cease when the muscular mischief was ended, but continued so long as the nervous effects remained and caused total or partial incapacity for work.

EAVES' case (supra) was followed in CHARLES WALL LTD. v. STEEL (1915), where a builders' labourer in March 1913 suffered an injury to his head, but the wound was completely healed by July 1913. In September 1914, the employers applied to diminish the compensation which they were paying him, on the ground that he was fit for light work, which they had offered him, but which he had refused. The medical evidence was conflicting, but the medical assessor reported that, although he could do light work on the level, he was not a malingerer and genuinely believed he was unable to work. The County Court Judge found that the workman honestly believed he was incapable of work, and that his condition was due to neurasthenia resulting from the accident, but he strongly advised the man to try and get work. He dismissed the application, and it was held by the Court of Appeal (Phillimore, L. J., dissenting) that there was evidence to justify him doing so.

But to entitle the workman to a continuance of the compensation, the neurasthenia must be genuine and there must be no suspicion of malingering. When the nervousness resulting from the accident is such that a reasonable man could overcome by making a genuine effort to work, the decision in EAVES v. BLAENCLYDACH COLLIERY CO., LTD. (subra) does not apply. For instance, in Turner v. Brooks and Doxey Ltd. (1909) the County Court Judge found that the refusal of a workman to continue work was due to nervousness which an average reasonable man would overcome and, although the nervousness was due to the accident, he declined to award compensation. The Court of Appeal agreed with his decision, Lord Cozens-Hardy, M.R., saying that he had no doubt that the learned Judge meant to find that the man was perfectly able to work and that the result of payment of compensation would take away all stimulus to do so. A somewhat similar decision was given in Holt v. Yates and Thom (1909) where it was held that the Arbitrator was right in finding that a man, who was not suffering from any incapacity for work as a result of the injury, but where inability to work was caused by brooding over the effects of the accident, was not incapacitated within the meaning of the Act.

In Higgs and Hills v. Unicume (1913) the County Court Judge terminated compensation on the grounds that the workman had unreasonably refused an offer of light work; that an average reasonable man suffering as he did would long ago have gone back to work; that, acting on unwise medical advice, and under the domination of his wife, he had behaved in an unreasonable way, but was not a malingerer; that he was suffering from weakness of will and a fixed, but erroneous, idea that he was a chronic invalid; and that a continuance of compensation was likely to keep up his present condition. It was held that, on these findings, the workman's condition was not the result of the accident. But in Stride v. Southampton Gas Light and Coke Co., Ltd. (1916) where a workman's legs were paralysed owing to loss of will power as the result of an accident, the Court of Appeal held that there being no evidence that light work which the applicant could perform was available, and no evidence of unreasonable conduct or malingering on his part, the Arbitrator was wrong in reducing the compensation to 1d. per week and that the award should have been on the basis of total incapacity.

<sup>&</sup>lt;sup>1</sup> Elliott's Workmen's Compensation Acts, 9th Ed., and Willis's Workmen's Compensation, 34th Ed.

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"The learned County Court Judge," said Lord Cozens-Hardy, M.R., "seems to me to have overlooked the fact that the loss of will power is just as much a result of the accident as any objective symptoms would be."

In Yates v. South Kirkby &c., Collieres Ltd. (1910) the doctrine established in Eaves v. Blaenclydach Colliery Co., Ltd. was extended to a remarkable degree. Here there was no traumatic neurasthenia, because the workman had not suffered any specific injury by the accident; he merely sustained a shock to his nervous system through the excitement and alarm caused by seeing the effects of an accident to a fellow-workman. Owing to the shock, neurasthenia supervened and rendered him unable to follow his usual occupation, and it was held that the incapacity resulted from "personal injury by accident".

In that case the collier suffered no specific injury but it was held that a nervous shock causing incapacity to work was as much a "personal injury by accident" as a broken limb or other physical injury.

The Courts have also considered cases where the incapacity for work has been caused through loafing. In one case the Court decided that if a workman's incapacity (for example the soft condition of his muscles), is brought about by loafing the Court Court Judge may justly terminate or reduce the compensation [David v. Windsor Coal (1911)]; but in another case the Court declined to do so if the workman's physical incapacity is due to his not working and he has tried but failed to obtain employment suited to his condition [Bonsall v. Midland Colliery Comp. (1914)].

The reasonableness or unreasonableness of the workman's conduct and its effects are questions of fact.

Since these cases were decided the law has been amended to the advantage of the workman by a Workmen's Compensation Act 1931. The material part is as follows:

If a workman who has so far recovered from the injury as to be fit for employment of a certain kind has failed to obtain employment and it appears to the County Court ludge either—

- that, having regard to all the circumstances, it is probable that the workman would, but for the continuing effects of the injury, be able to obtain work in the same grade in the same class of employment as before the accident; or
- (2) that his failure to obtain employment is a consequence, wholly or mainly, of the injury.

the judge shall order that the workman's incapacity shall be treated as total incapacity resulting from the injury for such period, and subject to such conditions, as may be provided by the order, without prejudice, however, to the right of review conferred by this Act:

#### Provided that-

- (1) no order shall be made under this subsection if it appears to the judge that the workman has not taken all reasonable steps to obtain employment; and
- (2) every such order shall be made subject to the condition that it shall cease to be in force if the workman receives unemployment benefit.

This Act only applies if there is partial incapacity for work. It has no application if there has been complete recovery so that all incapacity is negatived. In cases of partial incapacity the employer who seeks to diminish the payments of compensation should prove that suitable employment is available for the workman, and that he is capable of doing such work. The medical witness should know what the work is and be able to say that the workman can do it. That being so, before going into the witness box the medical witness should if possible see the work that the employers offer to the workman so that he can say that he knows what the work is, and then he can say whether or not such work is within the capacity of the workman.

I have tried to state the law as it is to-day. If you are not satisfied with it as it is then your Society should consider in what way the law should be amended. It may be your view that in the workman's interest and in the public interest more power should be given to the Court to suspend the payments of compensation in a case where incapacity results from mere nervous effects or loss of will power or by brooding over the effects of an accident that a reasonable workman in his own interest should overcome.

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In other words you may consider that more power to suspend payments of compensation should be given to the Court in cases where the payment of compensation is the main factor in prolonging invalidism; if that is so, your Society should formulate its proposed amendments with evidence and reasons to support them and submit them to the Home Office for consideration.

His Honour then referred to the reports of the important and recent legal decisions upon this subject and read a number of extracts from the judgments in support of his views.

Mr. H. E. Griffiths: The part which the Workmen's Compensation Act takes in prolonging invalidism after an accident may be summarized as follows: (1) The Toxins of Man's Imagined Rights. (2) The Pest of the Lump-Sum Settlement. (3) The Curse of Under-Nourishment. (4) The Plague of Light Work. (5) The Scourge of Over-Treatment.

### (1) The Toxins of Man's Imagined Rights

In the majority of cases which I have seen in which I felt that prolongation of disability after an accident was due indirectly to the Workmen's Compensation Acts, a predominant factor was the patient's mistaken idea of his rights to a lump sum payment. Actually, in the Workmen's Compensation Act, contrary to the belief of all patients and most doctors, there is no right to lump sum payment, except in those cases in which the accident proved fatal. The workman's sole "right" is to the payment of weekly compensation during incapacity from earning—and here again the Acts are misunderstood, because there is a vast difference between disability and incapacity from earning.

There is, however, provision in the Acts for the lump sum settlement of claims by agreement between the parties, subject to the settlement being passed by the Registrar or Judge of the County Court. Since this settlement is not a "right" but only an "agreement", it leads to endless and often bitter wrangling.

Throughout all this the workman's determination to defend his imagined rights becomes more and more fixed, and the ground for the development of all the mind disorders which Dr. Bernard Hart has dealt with becomes more intensely fertilized.

#### (2) The Pest of the Lump Sum Settlement

Now that the turmoil of the fight for "right" is over, the workman has been paid his lump sum. He has repaid out of it money advanced by the Public Assistance Board, and has settled his personal and often pitiful debts and perhaps been able to redeem some of his household possessions. Perhaps there is still a little money left over.

How far does this affect the period of invalidism?

A great deal of evidence on this subject was offered by the Stewart Committee, the Delevigne Committee, and before the Royal Commission on Workmen's Compensation. Before the Stewart Committee and the Delevigne Committee the evidence was almost unanimous in stating that the settlement of the claim by a lump sum payment operated to the physical and mental benefit of the patient and indirectly to his material welfare. The only contradictory evidence was that given by the representative of the Ministry of Pensions before the Delevigne Committee. Curiously all the other evidence was based upon opinion: the only evidence of fact was that given by the Ministry of Pensions.

But the evidence given before the Royal Commission on Workmen's Compensation was almost unanimous in condemning lump sum payment as a factor in rehabilitating the injured workman.

There can be no doubt that in the case of minor injuries rapid settlement of the claim by lump sum payment shortens the period of invalidism, but in the case of major disability with permanent incapacity, lump sum payment is an unmitigated evil.

An investigation was undertaken for the New York State Education Department by

An investigation was undertaken for the New York State Education Department by Dr. Carl Narcross. He investigated 321 cases three years after their settlement by payment of a sum of upwards of 1,000 dollars, with an average payment of nearly 3,000 dollars.

In the 67 neuroses that occurred amongst the 321, one case had made a complete recovery. The remaining 66 divided into three equal groups. The first 22 had improved and were back at work but their average weekly earnings were down by over 40%. The second 22 had not improved but they were back at work with their average weekly earnings down by over 60%. The third 22 had deteriorated: none was at work, 2 were dead, 17 were "on the rates". Of the remainder of the 321 several had developed neuroses since the settlement of their claims.

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#### (3) The Curse of Under-Nourishment

In the Interdepartmental Committee Report on Rehabilitation, which was published in 1939, in a passage referring to industrial injuries, the statement is made that: "The out-patient departments of our hospitals are crowded with patients suffering from the combined disabilities of injury and under-nourishment."

This is a reference to an investigation of mine into a very large number of industrial injuries, which showed that in the out-patient departments of our hospitals in London the average workman in receipt of Workmen's Compensation showed evidence of malnutrition within six weeks of his attendance as an out-patient. The reason is clear. In pre-war days the maximum weekly sum paid under the Workmen's Compensation Act was 30/-, and in big cities this is quite insufficient to pay for rent and food for the average-sized workman's family. Undernourishment amongst the industrially injured city dwellers is one of the prime factors in the greater prolongation of invalidism in the town than in the country.

In Russia the law recognizes the fact that nourishment plays an important part in recovery from injury and disease, and it stipulates that the workman shall have his full pay, and in special circumstances 25% more pay, when incapacitated by injury.

#### (4) The Plague of Light Work

Under the provisions of the Light Work Clauses in the Workmen's Compensation Acts both before and after 1931, the employer may reduce the amount of the weekly payment of compensation to the workman if he can show that the workman is fit to undertake light work and if light work is available. When the Light Work Clause first became law it was thought, or perhaps hoped, that light work would help to rehabilitate the patient. The evidence given by the British Medical Association before the Royal Commission on Workmen's Compensation has abundantly proved the opposite, and the reasons are not far to seek.

In the majority of trades in which accidents occur there is no real light work and jobs are made by the employer for the workman at the instigation of the insurers. In the building trade, for instance, a skilled artisan has to become a tea-boy or a sweeper-up, and an inferiority complex, perhaps not present before, is immediately born and with it a sense of bitter resentment against his employers and against fate. In another case a skilled workman, perhaps a mechanic, is given specially selected light jobs in his trade. It is true that this occasionally helps him to get better, but more often, because he has to work in pain even at the light tasks which he is doing, pain and work become linked in his mind and his sense of incapacity is driven home with increasing force each time he tries to turn a spanner.

A year or two ago a man who was making a rapid progress towards recovery after a fracture insisted on leaving my gymnasium to do a light job found by his employer, both parties being satisfied that he would be fit in a matter of days. He came to the hospital six months later not as fit as when he left it. When I asked him what he was doing and if he was still working, he replied: "Oh, yes. I'm with the other cripples." This man's light work had consisted in sail repairing with three other men who were permanently incapacitated.

#### (5) The Scourge of Over-treatment

There is one disease which I believe to be definitely attributable to the Workmen's Compensation Acts, which I will call "Recurrent Painful Nerve Endings". It is a condition which I have only seen arise in patients in receipt of Workmen's Compensation or in expectation or hope of a lump sum settlement. I have never seen it in patients in receipt of National Health Insurance, where, of course, there is no right, real or fancied, to lump sum payment.

We are all familiar with the painful stump resulting from partial amputation of the finger, in some cases with and in some without a definite amputation neuroma. The condition is quite easily dealt with surgically in uncomplicated cases, but where Workmen's Compensation is a complication, it is my experience that any form of treatment is invariably followed by resurrence of the pain in a more intensified form.

invariably followed by recurrence of the pain in a more intensified form.

As soon as the claim is settled radical treatment, by whatever method, is invariably successful.

The folly of operating on these cases whilst there is a claim pending cannot be too strongly condemned: in my view it amounts to malpractice.

A milkman who lost the tip of the little finger of the left hand developed a painful scar. Although he was fit for most of his work I advised the Insurance Company to settle

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the claim by the payment of the £10 which he wanted. Other counsels prevailed; the man had his nerve injected with alcohol; he next had the finger amputated at the distal interphalangeal joint and then at the proximal interphalangeal joint; at a later stage at the knuckle. The next operation removed the 5th metacarpal bone, but still intense pain persisted. The last operation was for amputation of the ring finger and of the 4th metacarpal bone—all of the hand supplied by the ulnar nerve. The case was finally settled by a payment of £600 and the man, I am informed, lost his pain. Let it be clearly understood that this man was not malingering. He did have genuine return of pain with increasing severity. He did develop bulbous nerve endings which were easily seen beneath the skin.

Finally, the ignorance of the doctor who treats the patient or supplies the weekly certificate is as much to blame as any other factor in the Compensation law in keeping the man away from work. Because the man has lost a digit, or has a little shortening of the leg, or has not got full movement of a joint, he is advised by the doctor that he is not fit to do the work of a greasy birler or of some other occupation of which he has not the slightest idea what are or are not its anatomical or physiological requirements.

The tragedy of the Workmen's Compensation law is that it was born out of season, before National Health Insurance.

Prof. Hermann Levy (co-author of "Workmen's Compensation", Vols. I and II, Oxford) said that the Workmen's Compensation Acts in Britain not only lacked any provisions to accelerate the recovery of the injured worker, but actually contained many provisions which tended to prolong sickness. Lump sum settlements were only one instance. They were not the result of any recommendations made by the medical profession, but mainly provided for the benefit of the insurance companies which liked to clear their accounts of liabilities and which used such agreements as a means of bargaining. Further, the will of the injured to resume work was constantly hampered by the insecurity of his future position. Would he get "light work" and what kind of light work? What would happen to him if by resuming some work there might come an aggravation or recrudescence of the injury? Insurance companies were eager to reduce the compensation payment from that for full incapacity to that for partial incapacity, but the worker's doctor was frequently disposed to reject offers of "light work" and even of operations in the interest of the injured. There was in Britain no compensation fund for second injuries, and this led to a reluctance on the part of employers to employ partially disabled workers. All such factors coupled sometimes with an endless litigation led to a feeling of insecurity on the part of the injured worker which again reacted unfavourably on his will for recovery and created neurotic fear. The creation of a Workmen's Compensation Board with a Board of Medical Referees, both being representative of employers' and employees' interests, would in conjunction with measures for rehabilitation and the re-settlement of partially disabled workers bring the necessary improvement of the present position. Moreover, groups of industry might form collective bodies dealing with accident prevention, compensation and rehabilitation under the guidance and control of the National or Regional Workmen's Compensation Boards,

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### JOINT DISCUSSION No. 4

### Sections of Neurology and Orthopædics

Chairman—George Riddoch, M.D. (President of the Section of Neurology.)

[January 17, 1942]

#### DISCUSSION ON SCIATIC PAIN

Dr. Purdon Martin: "Sciatic" means referring to the socket of the hip-joint. The Romans called this socket "the vinegar cup" (acetabulum) and perhaps for this name there were more reasons than meet the eye of the anatomist.

By sciatic pain, I mean pain referred to the course and distribution of the great sciatic nerve and I do not apply the term to any other pain in the lower limb. The nerve is situated very deeply in the buttock, and runs down the middle of the back of the thigh, under cover of the long head of the biceps femoris. Its cutaneous sensory distribution is limited to areas on the foot and lower two-thirds of the leg, but this is not the distribution of sciatic pain. The nerve gives motor branches, and evidently also, branches conveying deep pain sensation, to all the muscles on the back of the thigh, and to the muscles on the back and outer side of the leg. While there may be hyperæsthesia in the cutaneous distribution, sciatic pain is typically a deep pain, and is felt in the muscles. The pain may be severe, but even when it is not severe, there is a sensation of discomfort in the muscles and the patient moves them frequently to try and get relief. In many cases there is also pain in the buttock. Among the associated phenomena are tenderness along the course of the sciatic nerve and pain excited when the extended leg is flexed at the hip. The former is usually attributed to tenderness of the nerve trunk itself, but it is doubtful whether this is always justifiable. I have observed that the muscles on the outer side of the leg may be tender when there is no tenderness of the common peroneal nerve at the neck of the fibula. Possibly the tenderness attributed to the sciatic nerve is often due to hyperalgesia of the muscles, and if so, the long head of the biceps femoris and the calf muscles must be particularly sensitive. As regards the so-called stretching of the nerve, it is doubtful whether the nerve is actually stretched by the usual manœuvre. and it seems more likely that the pain which is excited is due to the stretching of the hyperalgesic muscles. There is a degree of spasm of these muscles. The pain has been attributed to stretching of the inflamed nerve and even to adhesions between the nerve and surrounding tissues, but in cases of referred sciatic pain this phenomenon is present but it can be abolished at once by anæsthetization of the exciting focus of the pain, so that it cannot in those cases be due to inflammation or adhesions.

Causes of sciatic pain.—We recognize two groups of causes of sciatic pain, viz. disturbances affecting the nerve itself, and pain referred into the distribution of the sciatic nerve. As the latter is the more common I will refer to it first.

Mackenzie's conception that referred pain was due to what he called "an irritable focus in the spinal cord" has stood the test of time, and it received strong support from Sherrington's demonstration of a "central excitatory state" affecting the motor cells in the spinal cord. The cells implicated in referred pain are those situated in the posterior horn of the grev matter, and these form in the cord a continuous column which is not While referred pain produced by a moderate stimulus is more or less segmented. segmental, it may, with a more intense exciting cause, affect several segments, or, on the other hand, only a portion of one segment, or adjacent portions of adjoining segments. It is consequently spinal, but not strictly segmental, and we should not expect to find it so. Referred pain causes a hypersensitive state in all the structures within a certain territory and consequently the muscles, as well as the skin are hyperalgesic. cause some exaltation of function, but it cannot cause any diminution of function or any impairment or abolition of reflexes. The chief sources from which pain is referred into the sciatic distribution are: arthritis of the hip, and perhaps also arthritis of the lumbar spine, disturbance of the spinal ligaments and local painful areas in the lumbar and gluteal muscles. In certain cases of malignant disease of the lumbar vertebræ pain may be present in the sciatic distribution at a time when no abnormality can be detected in

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X-ray films of the vertebral column; there is no loss of the ankle-jerk, or other sign of impairment of the function of the sciatic nerve, and I believe the pain in these cases at this stage is a referrred pain arising from the diseased bone. The treatment of referred pain is the treatment of the primary source, usually the hip-joint. Local foci of exciting pain can sometimes be treated by injection. Wilfrid Harris was using this method twenty years ago, employing quinine urea, and later, very small injections of alcohol, and in the last few years Kellgren has used novocain preparations with considerable success.

The disturbances which may affect the nerve itself or its roots, are many, but I will refer only to protrusion of the nucleus of an intervertebral disc, and to interstitial neuritis. It is now three years since Love came over here and gave us a paper on protrusion of the nucleus of the intervertebral disc (*Proceedings*, 1939, 32, 1697), but we are still somewhat weak in the diagnosis of this condition. The symptoms, if the lesion is in the lumbar spine are: sciatic pain, pain in the back, stiffness of the spine and some deformity of the spine, such as reduction of the normal curve, or scoliosis; the pain is intensified by coughing or sneezing, and typically it is subject to remissions. The protruded nucleus irritates an emerging spinal root and so causes pain referred to the distribution by that root. This is undoubtedly the same condition as the sciatique radiculaire—a sciatica affecting a single spinal root-described by Déjerine in the early years of this century, and the exponents of protruded intervertebral discs have not yet added anything to the account which Déjerine gave of the symptomatology of "radicular sciatica". In these cases in which usually a single spinal root is affected the problem of diagnosis resolves itself, as in other neurological conditions, into the two questions: Where is the lesion? What is the lesion? The nervous signs and symptoms enable us to answer the first question; for the answer to the second we must turn to the general examination of the patient, special investigations and the history. The site of the lesion causing irritation of a single root is determined by the distribution of the pain and by signs of interference with root function, such as sensory impairment, or loss of the ankle-jerk (usually weakened with the 5th lumbar and lost with 1st sacral lesions). Dandy, in his most recent paper, quotes Love for the statement that 96% of all disc lesions affect either the 4th or 5th lumbar intervertebral disc, and consequently the roots involved are the 5th lumbar or 1st sacral. To recognize with confidence the nature of the lesion we must determine the syndrome associated with injury of the disc itself and so far it is not very well defined. The pain in the back is probably a referred pain arising either from the damaged disc or from ligaments under The spinal deformity is either due to the injury to the disc, or, more probably, is protective. I do not think the possibilities of diagnosis by clinical observation are yet by any means exhausted. A history of injury is suggestive but can be misleading. regards special investigations, the simple X-ray appearances are not as a rule very helpful in the differential diagnosis, and the C.S.F. findings are by no means typical. We are consequently dependent on the use of X-ray examination with contrast media. At first we depended on lipiodol and, more recently, air has been used. Lipiodol is not to be used lightly, and it should not be injected unless the X-ray examination can be carried out under the most favourable conditions. I believe as we become more familiar with this condition, and recognize the clinical syndrome arising from rupture of the disc at whatever level, we shall be able to make the diagnosis without the use of contrast media. In fact, I believe that we shall do better than with contrast media, because there must be some cases in which the protruded nucleus does not cause any constriction of the theca, and in such cases contrast media may mislead us.

In dealing with the cases in which sciatic pain is a consequence of the rupture of an intervertebral disc, we have, perhaps, not given sufficient weight to the fact that there are two more or less separate conditions to be treated. The irritation of one of the roots of the sciatic nerve by the extruded nucleus of the disc is, in fact, only a complication, and when the irritating element has been removed by operation, we have still only treated the complication. It is true that there are many fortunate cases in which the primary condition—the injury of the vertebral column—gives rise to few symptoms, but we cannot reasonably expect that the patient will be relieved of all his symptoms unless the primary condition is treated, as well as the complication.

Finally, there is such a thing as sciatic interstitial neuritis. A similar clinical condition may be observed in many other spinal nerves where the irritation is certainly not due to protruded discs and it is very often associated with arthritis. Recent pathological confirmation for the sciatic nerve is admittedly lacking, but Ballance and Duel found in the facial nerve thickening of the interstitial tissue, and thickening and scarring of the sheath. In the sciatic nerve the outstanding symptom is pain, but there are signs also of interference with nerve function; the ankle-jerk is likely to be lost and after a time there is slight wasting or flattening of the calf muscles. The signs and symptoms in these cases of neuritis are not localized to the distribution of a single spinal root; there are usually

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indications that the inflammation is more widespread in the lumbosacral plexus. For instance, I have noticed that there is very frequently a tender point below the outer part of the crest of the ilium, about the termination of the iliac branch of the ilio-hypogastric nerve, which is derived from the 1st lumbar root. The course of these cases, too, is different from that of the cases of ruptured intervertebral discs, and does not show the remissions which characterize the pain of the latter.

Mr. V. H. Ellis: Sciatic pain may be due to causes (1) arising within the nerve or its central connexions; (2) producing irritation of the nerve or its roots from without; (3) stimulating nerve endings of similar segmental distribution in other areas of the body from which pain is referred to the sciatic area.

(1) In the first class we have the classical cause of sciatic pain, namely, neuritis. Sciatic pain is associated with tabes, with diabetes and presumably, therefore, with other toxins. Causes arising in the first class are by far the most infrequent cause of sciatic pain

(2) Irritation of the nerve or its roots from without, is now attracting attention owing to its proved frequency, its more definite pathology and its successful treatment. It must be remembered that not only lesions of the intervertebral disc come into this class but also intraspinal tumours, subarachnoid adhesions and possibly also irritation of the roots by spinal osteophytes and tumours in the pelvis. For instance it has been found that 8% of cases of tuberculous caries of the sacro-iliac joints present sciatic symptoms. It is often said that sciatic pain can be due to the pressure of a tumour on a nerve root. But pressure on a nerve most usually produces paralysis or anæsthesia. Movement plus pressure is required to elicit pain. This factor may account for some of the successes of empirical treatment which will be referred to later.

(3) Before discussing in more detail the pathology and treatment of this class of sciatic pain, the third class must be considered. It is probable that the majority of cases of sciatic pain are of the referred type. It is true that most of them are of the more transient and less severe kind. A lesion of any type of tissue could be responsible for this stimulus though I think skin and the viscera are unlikely, but fascia, muscle, ligament and periosteum may provide the focus. Whatever we may believe about the pathology and causation of fibrositis this is undoubtedly a common cause of sciatic pain.

Injuries and the irritation of nerve endings in ligaments have been proved experimentally to cause sciatic pain, anæsthetization of such a ligament has relieved it. Ligaments are most commonly injured by stretching, either sudden or gradual, and the interspinous ligaments are obviously liable to both postural and traumatic strains.

Let us consider the causes of sciatica which have recently sprung into prominence. Rupture of an intervertebral disc suggests a severe traumatic strain of an intervertebral joint (if we exclude clumsy lumbar puncture). Hypertrophy of the ligamentum subflavum suggests a similar ætiology. With interspinous ligament strain we have here three real causes of sciatic pain which may often be associated.

However, I submit that movement is required to elicit pain in each and all of these cases for the following reasons: (1) Sciatica can nearly always be relieved by complete immobilization of the lumbar spine. Even the relative immobilization of plaster of Paris is often effective. (2) Fusion of the lumbar spine relieves symptoms in disc and other lesions (Farrell, B. P., and MacCracken, W. R., J. Bone & Joint Surg., 1941, 23, 457). (3) That prolapse of the disc is not the only operative factor in many cases is suggested by (a) J. S. Barr and W. J. Mixter (J. Bone & Joint. Surg., 1941, 23, 444) who found that fusion after laminectomy gave better results (see Table below); and they say that 30%

Persistent sciatica		Results without fusion		
	 	 9%	 	31%
Low back pain	 	 27%	 	48%

of cases should be fused. (b) Watson Jones recommends posterior root division after disc removal to avoid recurrences (Watson Jones, R., "Fractures", Edinburgh, 1939, p. 252).

With these considerations we begin to see a much wider cause of sciatica—what may be called intervertebral strain of which the ruptured disc may be merely a complication.

Laminectomy for sciatica where no prolapsed disc has been found fortunately often cures the symptom as well as allowing removal of lipiodol. Does the removal of a strained ligament cure it? If, as I suppose, ligamentous strain is a common cause of sciatica, Kellgren's method of novocain injection will often be of value in this as I have often proved it to be in the so-called fibrositic type. It also explains some of the occasional successes and aggravating failures of manipulation.

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Sceptics of the teachings of Leriche do not understand how novocain cures sprained ligaments. But the treatment is effective, and I believe a large number of cases of sciatica would be amenable to this form of treatment if the affected ligaments could be found, and injected, which may be technically very difficult. There seems no reason why anterior as well as posterior ligaments in the lumbosacral or even sacro-iliac region may not be at fault.

Before considering the treatment of sciatic pain the differential diagnosis of the three types must be determined.

The first presents the greatest difficulties unless other nerves are affected in the same manner. The absence of a history of trauma or precursory low back pain with the evidence of some general disease or toxæmia, would be helpful. Tenderness of the nerve itself is difficult to differentiate from tenderness of the structures overlying the nerve which may be present in any case of sciatic pain. Relief of pain following anæsthesia of the sciatic nerve trunk would be very suggestive though I have never yet been successful in such an attempt (possibly because I have never met a case of sciatic neuritis) and even this procedure would not relieve a radiculitis.

Differentiation between the second and third classes should be easier, but does not always prove so in practice. Possibly this is because, as already pointed out, both classes may be present in the same case. With definite pressure upon and irritation of a nerve root, signs as well as symptoms might be expected and in fact they are seldom absent in well marked cases. Loss of ankle-jerk is not uncommon, though possibly only when the 1st sacral root is involved. It is difficult to see how loss of ankle-jerk could be the accompaniment of purely referred pain. Similarly actual weakness of muscles supplied by the sciatic nerve suggests direct involvement of the parent root. Although anæsthesia is not to be expected from the involvement of a single root, changes in sensation are common and may be due to partial denervation of the skin as suggested by Weddell [Proc. Roy. Soc. Med. (1941), 34, 777 (Sect. Neurol., 33)] in recovering nerve lesions. Though local signs are therefore usually present in a well-marked case they are generally insufficient to prove or to localize the lesion. The history is of great importance; although considerable trauma might reasonably be required to rupture a disc such a story is often not obtained, mere forward flexion or weight lifting being held responsible.

One curious thing is the rarity of sciatic pain following compression fracture of the spine and tuberculous disease, in both of which the intervertebral disc is grossly affected.

The diagnosis of referred sciatic pain is largely made by elimination of the second class, by finding evidence of fibrositis or tenderness due to local trauma in the low back. Kellgren's method of novocain injection is both diagnostic and curative. I believe that cases of this class rarely present clinical signs in the affected limb.

Treatment.—Movement as well as other factors being usually required to produce sciatic pain, it is obvious that immobilization of the lumbar spine will usually give relief. This may vary from rest in bed, through the fixation in plaster, to fusion of the spine and it is questionable at what point the patient will consider the treatment worse than the disease. Application of a plaster jacket in suspension, possibly prolonged into a short hip spica will give relief even in many cases of protruded disc. It is possible that here in addition to immobilization reduction of the disc may occur. It is doubtful whether such a reduction can be permanent by healing of the ruptured fibrous ring and relapse often occurs on mobilization. I have had what appears to be permanent relief in non-fibrotic cases of sciatic pain both by this method and by simple traction of the affected limb in recumbency. A 10 lb. weight applied by strapping extension with the recumbent patient on a tilted bed is easily applied. It will give relief in two or three days if at all. It is not too tiresome for the patient and is without risk. If it gives relief it should be continued for three weeks. Although manipulation of the spine under anæsthesia gives relief to some cases it is dangerous unless the possibility of a ruptured disc is first excluded.

Omitting the effects of the trauma of operation which are rapidly decreasing with improved technique, the mechanics of the spine are abnormal both before and after operation. Removal of the protruded disc may relieve the symptom but one hydraulic shock absorber is out of action, one set of interspinous ligaments may still be seriously strained, and the faulty mechanics which allowed the original lesion are still present. Orthopædic treatment to correct posture or improve muscle tone may prevent chronic low back pain if not a possible recurrence of sciatic pain.

Dr. Frank A. Elliott: Since the sciatic nerve and its radicles are the final common path for impulses from a number of important structures, it is to be expected that sciatic pain may have many causes. So much is generally admitted. What there is no agreement

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same evidierve ierve nesia ssful even about is the relative importance of one cause as against another. Some authors find arthritis of the hip the commonest cause. Others claim priority for low back strain. A third group accepts herniation of the nucleus pulposus as the most important factor, and so on. I suppose that to some extent these differences of opinion are due to the selected nature of the material which the specialist is called upon to see. I have collected a small series of unselected cases which were studied in order to view the sciatic problem as a whole. Of 115 cases seen, the pain was of true sciatic distribution in only 84. Pain limited to the posterior cutaneous nerve of the thigh was not regarded as sciatica. The findings are tabulated hereunder:

are tabulated in	cicunaci								
		1	DIAG	NOSIS					
									No.
Fibrositis	***	***		***			***	***	16
Neuritis	***	***	***	***	***		***	***	3
Radiculitis	***	***	***	***	***				2 4
Osteo-arthritis o									
Osteo-arthritis o		***	***	***	***		***	***	8
Sacro-iliac arthr		***	***		***	***	***	***	10
Tuberculo									
Subacute,				1 (10)					
With hom		sacra	lizat	ion (3)					
Pott's disease of									3
Malignant secon					0 0 0	0.0.0		0.0.0	7
Tumour of caud			***						3
Protrusion of nu					ral)			* * *	2
Chondroma of	intervert	ebral	disc	(L. 2)					1
Malinger						0 0 0			1
								-	
									60
Diagnosis unpro	oved	***	* * *	***	***	***	***	***	24
								Total	84

The cases of fibrositis were clear cut, with evidence of muscular rheumatism in other parts of the body. Where the diagnosis rested on the novocain injection method introduced by Steindler, the case was regarded as unproved owing to my experience that this test is occasionally unreliable. Neuritis, with its severe pain, hyperæsthesia, absent anklejerk, and prolonged course, so unlike any other cause of sciatic pain, was seen thrice. There were two young men with a high sciatica whose cerebrospinal fluid showed a protein of 110 mg. and 90 mg. respectively; laminectomy after equivocal lipiodol examination, was completely negative, and both cases made a slow recovery. I think these conform to the early descriptions of radiculitis. In four cases there was reason to suspect that sciatic and low back pain was associated with severe osteo-arthritic changes in the Professor Putti drew our attention to the possible importance lower lumbar vertebræ. of such a lumbar arthritis in the causation of sciatica. The difficulty is to demonstrate that the arthritis seen radiologically is the cause of the symptoms. My reason for tracing such a connexion in these four cases is that the injection of novocain into the intervertebral canals (i.e. the site of osteo-arthritic inflammation and compression) of the lower two lumbar roots gave complete though temporary relief from pain. In three cases the 5th root only was affected. In the fourth case both the 4th and the 5th foramina Osteo-arthritis of the hip appeared to be the source of the pain in had to be injected. eight cases, for the sciatic pain could be relieved by filling the joint space with isotonic 2% novocain. A supra-trochanteric approach was used, and the procedure was without ill-effects. The reason for doing it at all was the difficulty in knowing whether the sciatic pain was due to the arthritis itself, or whether it originated in an associated fibrositis or in the lumbar spondylitis which was so frequently present. In two cases, listed as undiagnosed, cocainization of the hip failed to relieve the pain, whereas a deep injection into the region of the transverse process of the 5th lumbar vertebra had an immediate and permanent effect. The fact that tuberculous and pyogenic disease of the hip do not give rise to sciatic pain is a further warning against assuming a direct connexion between the symptoms complained of and the arthritis which may be present. The diagnosis in ten cases of sacro-iliac arthritis rested on the radiological evidence of extensive and progressive destruction of one sacro-iliac joint as against a normal on the sound side. The clinical tests for disease in this joint were consistently unreliable in these cases; pain antedated both localizing signs and X-ray evidence by many months in some instances, leading to the use of lipiodol in one case. No cases of sacro-iliac strain were encountered. Two women presented the classical picture of sacro-iliac subluxation, but in both cases the pain was confined to the back of the thigh and they were therefore excluded from the series. I mention this to indicate to our orthopædic colleagues that the absence of these

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conditions from this small series does not mean that they were not looked for. They were, and with orthopædic assistance. I am surprised that Mr. Ellis should not have seen sciatica as a symptom of spinal tuberculosis; these three patients presented cold abscesses and were old neglected cases which would not normally have been seen by an orthopædic surgeon. There were seven cases of secondaries in the lower spine; in all seven the pelvis was clinically free from growth. Unless this is the case it is of course difficult to know whether the sciatic pain comes from the pelvis or the vertebræ. Tumour of the cauda equina was found three times, and it is interesting to note that one of these had suffered from lumbago and sciatica for seven years, dating from a strain of the back while lifting a heavy weight. She was in consequence treated as a low back sprain until neurological signs appeared. A confident diagnosis of herniated disc was then made, and at operation a neurofibroma was discovered to be the sole abnormality In the course of six laminectomies a herniated disc was found in two cases, radiculitis was present in two cases, in one there was a chondroma of the second lumbar disc; no abnormality was found in one, but the operation was curative and there has been no recurrence of pain for two years. Finally, there was one malingerer who had an absent ankle-jerk dating from a previous attack of sciatica, which the patient was able to reproduce in order to secure his discharge from the Army. This information was forthcoming during light narcosis. I include it because the psychological aspect of sciatic pain is a definite problem. Long-standing cases sometimes develop hysterical symptoms, and if seen for the first time, give the impression that there is nothing organically wrong. Oppenheimer described this long ago as "reflex hysteria". Another variation is an anxiety state grafted on to the organic nucleus and aggravated by the doubts and dissensions of too many bedside consultations.

Mr. Joe Pennybacker: It seems reasonable to approach the larger problem of pain in the lower limb by limiting the discussion to that group of cases complaining of pain in the sciatic distribution, with physical signs referable to the sciatic nerve or its component roots, and accepting only these as cases of sciatica. It is true that even this limitation will carry us to the borderland of the low back pain country, as a great number of cases of ordinary sciatica have had periods of low back pain.

My experience in the last few years has led me to the belief that the majority of these cases of sciatica are due to compression of one of the lower lumbar roots by a damaged intervertebral disc. When I tell you that I have seen this lesion verified at operation in some sixty cases in the past two and a half years, you will appreciate my difficulty in believing that this is a rare cause of sciatica. It is nearly three years since Love addressed a combined meeting of these sections, and focused attention on this lesion as a common cause of sciatica. That we have been slow in accepting it as such is perhaps characteristic of our conservatism in matters of treatment, and as long as we are willing to assess results without bias, there is something to be said for this attitude.

The cases on which I base these remarks were cases of ordinary sciatica; at least, all of them had been regarded as such by numerous therapists who had met with indifferent success in dealing with them. You may say that the fact that they had not responded to treatment takes them out of the class of ordinary sciatica, which in the vast majority of cases recovers spontaneously or in response to various physical measures, and never recurs. I doubt the validity of that reasoning, and mere impressions based on a long experience are not enough. It would be interesting to follow up a series of cases of sciatica treated conservatively, to see what has happened to them over the years. I know that some of the cases which would figure in such an analysis have ultimately had an operation for the removal of a prolapsed intervertebral disc.

There are several points in the syndrome which are not sufficiently appreciated. The possibility of such a lesion must be remembered in every case of sciatica, and the diagnosis can often be made from the history. Although the primordial pathology is not clearly understood, it seems reasonably certain that the lesion is traumatic. But the injury is usually a trivial one, and perhaps strain is a better term. The strain commonly occurs in flexion of the trunk: in lifting from the bending position, for instance. The injury may have been so trivial that it escaped notice or was forgotten, and frequently its discovery in the history is only at the expense of direct questioning. The immediate damage to the disc is followed by low back pain, often miscalled lumbago even by doctors who have had the affection in their own persons. This pain may be severe and disabling for a few days or it may only cause a slight discomfort in the back. It is easy to see how such an incident may be forgotten and not related to the sciatica. Even in the cases in which the sciatica follows more closely on the back pain, the memory of the back pain may be swamped in the more severe and present sciatic pain.

The neurological examination in the classical case reveals pain on the straight-leg raising test, some tenderness over the course of the sciatic nerve, weakness of the muscles

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below the knee, a diminished or absent ankle-jerk, and slight sensory impairment over the lateral border of the foot and ankle. But not all of these signs are present in every case. The commonest seems to be slight muscular weakness, especially in the dorsiflexors of the foot when these muscles are tested in action against resistance. This slight kinetic weakness is rarely of an order to have been noticed by the patient or to cause any abnormality of gait. Next most frequent is a slight impairment of cutaneous sensibility: loss of the tickle sense in testing with cotton-wool, and slight impairment to pin-prick over the lateral border of the foot and ankle. This latter examination demands some care, but the information it yields is worth the time spent in eliciting it.

The cerebrospinal fluid in the majority of cases is normal; a slight increase in the protein content is not uncommon, but a great increase should direct attention to one of the rarer causes of sciatic pain, such as an inflammatory process, tumour, angiomatous mal-At this point, I should say that in the cases of massive protrusions causing compression of the cauda equina, a great increase of protein is a common finding, and it is interesting to note that in these cases the fluid is usually withdrawn from above the level

of the lesion.

Ordinary X-rays of the spine are generally of little help. They will show the flattening of the lumbar curve, and the scoliosis which is commonly present, but the lesion itself is not visible. Nor is it often possible to say with certainty that a given intervertebral space is narrower than it should be, and hence the likely site of a protrusion of nuclear material.

Short of operation, the lesion can be demonstrated most convincingly by contrast myelography. In some clinics, air is used as the contrast medium and it is said to be very satisfactory. My own limited experience of the technique has not encouraged me to pursue it in the investigation of these cases. Lipiodol myelograms are easier to interpret, but as the stock of lipiodol in this country dates from before the fall of France, most of it now contains so much free iodine that it may set up troublesome irritant reactions in the theca, and on the whole it is better not to use it. With an adequate history and examination, it should be possible to make the diagnosis without contrast myelography, and if there was any doubt I should prefer an exploration to the instillation of lipiodol.

Cases which have been submitted to operation have been (1) cases of severe sciatica which in a given attack (usually not the very first) have not responded to rest or other measures; or (2) cases of recurring sciatica in which the frequent recurrences have led to domestic or economic hardships, or (3) more rarely, cases of compression of the cauda equina resulting from a massive protrusion. In this last connexion I have seen one such case following a manipulation for sciatica, and I know of others. Even though this is a rare sequel of manipulation, it is such a serious one, that I would be very hesitant about

advising manipulation for this complaint.

As to the technique, the lesion is much more easily seen and dealt with by the extradural than the intra-dural approach. I have seen several cases where there was nothing at all abnormal to be seen or felt within the theca, and yet the lesion was perfectly obvious when approached extrathecally. This may explain a certain number of negative explorations. In some cases, it is possible to deal with the lesion without removing any bone: the sacrospinalis muscle is cleared and retracted from the spinous processes and laminæ on the side of the lesion, the ligamentum flavum excised, and the lesion removed in the interval between the laminæ. In this manner the operation is limited to soft tissues, and it seems that convalescence is a little more rapid, and there may be less disturbance of the mechanics of the vertebral column than is entailed in the usual hemilaminectomy.

Group Captain C. P. Symonds said that in the discussion opened by Dr. Love in 1939, he had stated that the clinical syndrome reported in patients with prolapsed disc proved at operation was one which he had observed in scores of patients who had recovered with rest and warmth, without surgical intervention. He concluded that if prolapsed disc was anything but a very rare cause of sciatica it was a lesion in most cases capable of spontaneous repair. He had nothing to retract from this statement but something to add from his experience with Service patients in the past two and a half years. was convinced that in this group prolapsed disc was by far the commonest cause of sciatica. He further believed that there was a clinical syndrome characteristic of prolapsed disc, and that the diagnosis could therefore be made without recourse to contrast media. He was not yet convinced that operation offered a short cut to recovery in an attack of sciatica from this cause, or that the prospects of recurrence were any less in cases treated by operation than in medically treated cases. As far as Service patients were concerned operation, even in the best hands, had proved on the whole so unsuccessful in getting men back to duty that his present policy was to advise a prolonged period of immobilization and if this failed to render the man fit for duty within a reasonable time, to recommend invaliding.

Dr. Henry Wilson: The complaint of pain simulating neuralgia and neuritis interests the medical psychologist since he is asked to see such cases when medical, surgical, and physiotherapeutic measures have been unsuccessful,

That hysterical pain may occur in any organ is well known, but it only occurs if one of two conditions have been present: (a) Previous organic pain in that part; (b) in a dubious and much smaller number of cases, as a result of suggestion.

I have reviewed the notes of eighty patients with primary sciatica admitted to the London Hospital between 1937 and 1941 inclusive.

It was remarkable to find that house physicians, or registrars had mentioned irregularities in the patients' mental attitude in no fewer than twenty-five of the cases. arriving at this figure I have disregarded the word "anxious", since any patient with serious sciatic pain may well be this, nor have I included the word "exhausted" unless that has been expanded by other suggestions of neurosis. Thus to give a few examples: "always been a worriter", "suspicious", "psychoneurotic", "each form of therapy seems to occasion a fresh burst of complaints", "came on when he had a considerable amount of worry". In one woman with prolapsed discs it is stated that after ten days in hospital 'a remarkably quick improvement occurred when she wanted to go home"; one case immediately recovered when an epidural injection was proposed.

There seem to be two possible explanations of the frequency with which neurotic manifestations have been noted by non-skilled observers. The first is that quite apart from the initial pain the prolonged rest in bed produces those symptoms of irritability which may be shown by the most healthy when inactive. My impression from the notes is that the deviation from the normal in these cases was greater.

The second explanation is that a crippling and fairly lengthy illness encourages the

persistence of originally organic symptoms as a hysterical aftermath used for escapist or

If the question of suggested pain is disregarded hysterical pain in any part of the body is never primarily (in time) psychogenic. Pain at some time (remembered or not) has affected that area. Given the neurotic constitution together with the current problems organic sciatic pain may merge into hysterical sciatic pain, or hysterical sciatic pain may recur some time after the original attack of organic pain. The former wasting and altered reflexes may persist, and suggest a recurrence of organic disorder. Epidural injections and manipulations may be welcomed by the patient as focusing the attention away from the real seat of hysterical pain, i.e. the mind.

Is there any means whereby the perpetuation of symptoms for unconscious purposes may

If the first explanation advanced above is correct, i.e. that neurotic manifestations are the results of inactivity and invalidism, it is essential that directly the acute symptoms have subsided the patient has sufficient occupation for his active upper limbs and for his mind. Ways of achieving this were suggested by Jefferson [Proc. Roy. Soc. Med. (1942), 35, 295 (Sect. Neurol., 1)]

What of those other cases where the pain persists for escapist motives? The first necessity is that this possibility should be borne in mind, and that its frequency be recognized. Physical signs alone are misleading since absent ankle-jerks and wasted muscles may

Although non-organic pain may serve exhibitionistic, masochistic, or propitiatory motives it begins as an escape mechanism, and may sometimes, possibly frequently, be a form of malingering. This occurs more often than is recognized, and is the more likely the longer the period of primary inactivity. To assert that sciatic pain following trauma or neuritis is sometimes hysterical does not imply the necessity of long psychotherapy.

What is essential is early diagnosis of a psychological perpetuating cause, which should be followed by prompt adjustment of the environment so that the gain of the hysterical illness is reduced, and the disturbing mental factors fairly faced. My impression is that if the moment of psychiatric diagnosis is sufficiently early, long psychotherapy would be unnecessary, indeed it might well take the form of stimulating activity, once the escapist tendencies are recognized and discussed.

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# Section of Laryngology

President-E. D. D. Davis, F.R.C.S.

[March 6, 1942]

# DISCUSSION ON INJURIES OF THE NOSE AND THROAT

V. E. Negus: The proportion of injuries in the various regions is illustrated by a table showing the cases of injury to the head and neck treated at Horton Emergency Hospital. The table demonstrates that of all the head injuries admitted, just over half were cranio-cerebral, while the remainder affected regions other than the cranium. The nose and sinuses suffered relatively infrequently and the pharynx and larynx scarcely at all.

INJURIES OF THE HEAD AND NECK. ADMISSIONS TO HORTON EMERGENCY HOSPITAL FOR 8 MONTHS.

					Civilian	Service	Total
Total cases		***			1,476	2,441	3,917
Total head and no					372	205	577
Cranio-cerebral					214	113	327
Other regions of	head at	nd neck			157	126	283
Face		111			55	32	87
Eye	***		400		92	34	126
Nose and sinuses	***	***			10	5	15
Mouth and tongu				***	0	2	2
Mandible					5	7	12
Neck			***		4	10	14
Pharynx		***			0	1	1
Larvnx					0	1	1
Trachea				***	2	1	3
Bronchus (F.B.)					0	1	1
Ear					39	35	74
Wounds of other					51	31	82

Note.—The added total of head and neck cases is 610; the excess of 33 over the number given as 577 refers to combined injuries.

## Nose

Hæmatoma of the septum is to be expected and if present, free incision and evacuation are required, particularly if infection has occurred.

Much can be done to prevent infection if it is realized that the vestibule of each nasal fossa is heavily infected, while the regions lined by mucous membrane are practically

Mercurochrome in 2% solution or biniodide of mercury 1:500 in spirit, can be used, both for the vestibule and exterior of the nose. To maintain asepsis the patient should wear a small roll of gauze held in position over the nostrils by tapes tied behind the head.

For fracture of the nose with displacement, I have found a splint made of successive strips of broad ribbon gauze, to which collodion is applied with a brush, very convenient. Each layer is allowed to dry partially before the next is applied; eight thicknesses are sufficient.

## Para-nasal Sinuses

Simple injuries to the sinuses may be confined to effusion of blood into the antrum. Such a collection of fluid is best left alone, as it will in all probability absorb without immediate or subsequent trouble; here again, prevention of infection from the nostrils is of importance.

Simple fracture of the walls of sinuses may not call for treatment, except in special instances.

Depression of the lachrymal bone associated with inward displacement of part of the ethmoid plate, may lead to obstruction of the fronto-nasal duct, with subsequent headache; manipulation into normal position can be carried out with Walsham's forceps.

Compound fractures into the sinuses may present both cosmetic and functional diffi-

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culties. If the wound is clean, it may be possible to effect immediate closure without drainage. If, however, potential or actual sources of infection are present, it is desirable to provide free drainage, to cleanse lacerated skin edges, to remove foreign bodies and pieces of bone and then to dust the wound with sulphonamide powder. A full prophylactic course of sulphapyridine, 1 g. four-hourly, is given for three days. Failure to carry out this form of treatment, or excess of zeal in opening up bony layers or venous and lymphatic channels in early septic cases, may precipitate osteomyelitis, or thrombophlebitis, with possible spread to the meninges or the cavernous sinus.

After an interval of at least fourteen days, a further operation can be undertaken if

necessary, according to the site and type of injury.

The maxillary sinus, if containing pieces of metal or fragments of bone, must be opened by the sublabial route as soon as possible after the injury, unless the wound itself is of sufficient size for the removal of foreign bodies. If infection is present or impending, it is wise to provide an opening into the inferior meatus of the nose.

Clearance of the ethmoidal labyrinth may be required in injuries of this region, if infection is present; the operation should be postponed for at least fourteen days and

is best carried out by the external route.

If it appears that obstruction of the fronto-nasal duct might follow the operation, it is well to make a free communication between the nasal fossa and the frontal sinus

and to insert a skin graft, held in place by a rubber tube.

The frontal sinus, if injured, may present the double difficulty of cosmetic repair and functional restoration. If the anterior wall is depressed, but still more or less intact, elevation may be possible. If, on the other hand, the wound is severe and the cavity of the sinus infected, there will be swelling of the mucosa and blockage of the frontonasal duct, particularly if the injury extends downwards to the nose. In such a case it is essential to provide a free passage into the nose by enlarging the fronto-nasal duct; the operation should include the insertion of a skin graft.

If there be destruction of the anterior bony wall, it may be desirable to restore the lumen of the sinus and to replace its mutilated lining with a skin graft in the form of a sac, held in position by a bag of oiled silk packed with ribbon gauze. I have on two

or three occasions adopted this procedure with satisfactory results.

It is extremely difficult, if not impossible, to obliterate a frontal sinus and a pocket is liable to be left, with continuation of suppuration. The restoration of the lumen and provision of a free new fronto-nasal duct, eliminates this source of chronic infection and at the same time avoids the severe disfigurement resulting from destruction of the anterior wall. Insertion of fat or bone grafts in such cases offers difficulty because of the probability of sepsis.

Compound fracture involving the posterior wall of the frontal sinus is of serious

import and a radical operation may be indicated.

A further complication of a wound involving the ethmoidal and maxillary sinuses, in one case under my care, was penetration of the pterygo-maxillary fossa by a piece of

high explosive shell.

Fracture of the base of the skull may be of serious moment if it throws the meninges into communication with the nose or pharynx. The regions where this may occur are the nose, from fracture through the roof of the ethmoidal cells or cribriform plate, or in the nasopharynx. Escape of blood is not of so much significance as the presence of cerebrospinal fluid, indicating tearing of the dura.

If the cleft in the roof of the nose remains open, it may be necessary to refer the case to a neuro-surgeon, for closure with a graft of fascia lata or by some other method.

### Pharynx

Wounds of the pharynx are rare, because of the fatal result produced in most cases

by projectiles penetrating the neck.

There may be no marked symptoms following wounding of the pharynx by a piece of metal or other object, except for dysphagia, possibly of mild degree. I have removed from a bronchus a piece of high explosive shell which had passed through the side of the neck to enter the pharynx, whence it passed through the glottis; the patient was never seriously ill and suffered no apparent ill-effects.

If the patient survives perforation of the pharynx, he may be placed in a position of danger from infection of the para-pharyngeal space. Such an occurrence may cause death by spread to the mediastinum, by thrombophlebitis in veins of the neck, or by sloughing of one of the great vessels in the carotid sheath or of one of the branches.

It is imperative, therefore, to open widely any such infected wound, and sometimes it it advisable to tie the internal jugular vein.

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## Larynx

Indirect effects on the larynx are produced by certain wounds of the neck in which the vagus nerve is bruised or pressed upon by a hæmatoma. It is improbable that a patient with a divided vagus will survive, owing to its position in relation to the great vessels, and, therefore, the injury is unlikely to be due to division of the main trunk.

The effect is seen in paralysis of the recurrent nerve supplying one vocal cord, with disturbance of phonation, but with no severe upset of respiration; bilateral paralysis, with dyspnæa, is unlikely to occur. No treatment other than removal of the foreign body, is practicable; the paralysis may recover.

Simple direct injuries are produced by falls on the larynx or by motor or aeroplane cashes; they are unusual owing to the protection afforded by the lower jaw and sternum. They do occur, however, sometimes with such severe effects as complete occlusion of the dottis.

It is a general rule, in simple injuries of the larynx, to find that fracture of the thyroid cartilage is not of itself of serious import, but that fracture of the cricoid is dangerous because of subsequent obstruction to respiration. Tracheotomy is then called for as a life-saving measure, and later, relief of stenosis may be possible; it is wise to wait until all active inflammatory changes have subsided.

The method recommended is opening of the larynx, division of adherent surfaces, which may include the whole of the opposed surfaces of the vocal cords and subglottic areas, and removal of prominent masses of scar tissue; a lumen can thus be restored. To maintain patency, an effective method is the insertion of a rubber tube, held in position by transfixion with silver wire, as recommended by Schmiegelow.

An essential addition is the application of a skin graft to the divided surfaces; healing is thereby accelerated and recontraction avoided.

It may be necessary to keep the rubber tube in for as long as two months, if the cartilaginous framework is much damaged. In other cases, where the thyroid and cricoid cartilages are intact, as short a time as twelve days may be sufficient to obtain a permanent result.

Sometimes it is impossible to restore the airway sufficiently to permit of normal respiration and no more can be done than reconstruction of a passage sufficient for purposes of speech.

Compound fracture is of more serious account because of the danger of infection and particularly of perichondritis. Free exposure of the wound is required, with excision of lacerated skin edges; sulphonamide powder should be dusted into the wound, which is then kept widely open by a loose packing of gauze impregnated with iodoform. Trachcotomy may be required if much swelling is produced by hæmatoma formation or by inflammatory swelling.

Penetrating wounds of the larynx or trachea are rarely seen because of the liability to associated injury of the carotid sheath or the vertebral column. Should the patient survive these immediate dangers, he will be exposed to various others; such as hæmorrhage, fatal of itself or from flooding of the trachea, sepsis in the wound, with spread to the lungs causing septic bronchitis or bronchopneumonia, and finally perichondritis.

The immediate treatment consists in keeping the lungs clear of blood by allowing the patient to cough in the sitting posture and without the centrally depressing effect of morphia, or by the use of a suction pump; and in controlling hæmorrhage by pressure or the application of ligatures.

If there is a wide enough wound into the lumen of the larynx or trachea, it is permissible to insert through it a tracheal cannula as a temporary measure; it is imperative, however, that the tube should not remain in contact with the laryngeal cartilages for more than a few hours, as otherwise perichondritis will follow. The right procedure is, therefore, a correctly placed tracheotomy as soon as practicable. The wound itself should be laid freely open.

Possible sequelæ are immobility of the crico-arytenoid joints, with mechanical fixation of the cords, or stenosis from organization of granulations or from perichondritis.

The glottis and lumen of the trachea may be so narrowed that normal respiration is impossible; a permanent tracheotomy may be necessary, but sometimes it may be possible to restore the lumen by excision of scar tissue, with skin grafting, after all active inflammation has subsided.

Certain cases do not lend themselves to the operation described and it may be necessary to turn in skin flaps, to be united to the mucosa of the larynx or trachea and subsequently divided and folded in so as to restore the airway.

divided and folded in, so as to restore the airway.

Laryngo-\alpha sophageal fistula.— A condition disturbing to the patient and difficult for the surgeon, is traumatic fistula between the larynx or trachea and the \alpha sophagus. Food

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flows through into the airway on deglutition and seriously endangers the life of the patient.

A case under my care was operated on by the laryngo-fissure route, with the turning in of a skin flap; a successful result was obtained.

T. Pomfret Kilner: The plastic surgeon's contribution to any discussion of this kind must be of a pictorial character for his results are judged by external appearance. Nevertheless, it is essential in all reconstructive work that restoration of function should be constantly in the surgeon's mind.

## The Fractured Nose

Very few nose and throat surgeons are sufficiently radical in dealing with simple fractures of the nasal bones and many come into the hands of the plastic surgeon later when treatment is a much more difficult problem. Free disimpaction and mobilization under general anæsthesia are essential. It is a useful check on the efficacy of this treatment to make sure that the nose can be made to deviate readily to the side opposite to the original displacement. I usually employ a splint of dental modelling-wax moulded over lead but this is retained only until risk of displacement during the stage of recovery from the anæsthetic is over. I have often used with satisfaction the collodion-gauze splint described by Mr. Negus.

In more extensive fractures in this region Mr. Negus's advice that treatment should be delayed for ten to fourteen days in order to avoid risk of meningeal infection must be accepted though it has always been my practice to try to get the bone fragments back into normal position as soon as possible, feeling that by doing so I was re-establishing normal drainage channels. In cases where the crookedness of the nose is confined chiefly to the cartilaginous parts submucous resection is usually required for restoration of free nasal breathing and frequently this, if sufficiently radical, is followed by depression of the bridge line requiring a hinged cartilage graft.

Where, in addition to depression of profile, there is excessive breadth of the bony bridge a two-stage procedure is required, narrowing of the nose by infracture being followed by the insertion of a cartilage or bone graft. In many severe injuries a crush fracture of the nose is associated with posterior displacement of adjacent parts of the maxille. Where early treatment has failed to give correction of contour these cases should be treated as for syphilitic deformities. Building out the nasal bridge line alone is insufficient: restoration of the maxillary contour calls for freeing of the soft tissues from bone by skin graft introduced on Stent mould from an incision in the upper gingival sulcus. The mould is later replaced by a small vulcanite prosthesis or a projection from a denture.

#### Frontal Sinus Region

No restoration of contour in this region should be undertaken for at least six months after all discharge has ceased. Excision of a depressed scar can usually be carried out without reopening the sinus and after suitable undermining of the skin over the depressed area, a cartilage graft, suitably shaped to fill the defect, is inserted. In one of my cases the whole forehead region was sheared off by a propeller blade. There remained only scar tissue over the dura and both frontal sinuses lay open. After making sure that the sinuses opened freely into the nose, I closed them by folding over part of the mucosa and applied a large skin flap to cover the whole forehead area. At a later date contour was restored by strips of costal cartilage.

## Maxillary Sinus Region

Many penetrating wounds in this region close spontaneously but usually with deeply depressed scars, and frequently with troublesome  $\alpha$ dema of the lower eyelid. In many such cases it is possible to restore contour by excising the adherent scars and building out the depression by local flaps of deep tissue. Occasionally free fat grafts are needed while, where loss of tissue is extensive, both lining and covering skin flaps have to be provided.

In cases of fracture of the maxilla we use at Queen Mary's Hospital, Rochampton, a simple upper dental plate or metal cap splint with extra-oral projections (Kingsley) held up to a head cap or band. I aim at immediate rather than gradual replacement.

In the lantern slide records which I have shown you I have included a case of gross deformity following the removal of the maxilla for growth and would put forward a plea for the prevention of such deformity. Had the cheek cavity been filled out at the time of operation by a mould attached to a dental plate and carrying on its surface a Thiersch graft no contraction would have occurred and contour would have been readily restored by a simple dental appliance.

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# Malar and Zygomatic Regions

Fractures in this region are constantly overlooked. The immediate swelling is liable to mask the deformity but the clinical picture is usually a very clear one and radiological examination confirms the diagnosis. When the fracture involves the roof of the antrum, as it commonly does, the effects on the eye are so serious that early treatment is of paramount importance. In uncomplicated cases replacement is readily achieved by passing a lever from an incision in the temporal region on the surface of the temporal muscle until it lies deep to the zygoma. Manipulation then disimpacts the fracture and brings out the malar eminence in a most convincing manner. Occasionally difficulty is encountered in maintaining the bone in position and recourse is had to packing of the antrum through a Caldwell-Luc opening or to external support as suggested by Mowlem by wire passing through the antral wall to a projection on a head cap.

In established deformity from this type of fracture much may be achieved by fat or cartilage graft. Diplopia is corrected by inserting cartilage or fat under the periosteum of the depressed orbital floor.

#### Nose Loss

When only the skin of the nose is lost it is often possible to replace it by means of a free full-thickness skin graft. In cases where there has been both skin and bone loss it is sometimes possible to elevate the scarred area by cartilage graft but it is usually wiser to excise the scar and bring down a forehead flap before introducing supporting material.

Most cases of loss of part or the whole of the nose can be converted into a standard type of defect to which a suitably shaped flap, rolled in distally to make the nostrils, can be applied. Such a flap is best obtained from the forehead, but excellent results can be obtained by means of a short abdominal tubed pedicle flap temporarily transplanted to the wrist. Alternatively the necessary flap may be obtained from the chest wall and swung upwards from its upper attachment near the point of the shoulder.

Here are certain simple principles for all reconstructive work:

(1) The three layer construction of the face—covering, supporting (skeletal) and lining—should always be borne in mind.

(2) Accurate diagnosis must be made particularly in regard to loss or displacement of tissue.

(3) Careful search should be made for foreign bodies; ingrained dirt, wood, glass and clothing are as important as metal.

(4) Routine excision of wound margins, desirable elsewhere, has no place in facial surgery.

(5) Drainage of a wound for twenty-four to forty-eight hours is infinitely less troublesome than the treatment of a hæmatoma or its usual sequel in this region—an abscess.

(6) Close and friendly collaboration between throat, plastic, ophthalmic and dental surgeons is essential to success.

J. F. Simpson said fractures of the nose often produced obstruction of the nasolachrymal duct and should be dealt with by the rhinologist and ophthalmic surgeon working together. In performing the Toti operation in such cases the duct was found torn or compressed by flakes of bone. He supported the advisability of making an intra-nasal opening in cases of fracture involving the antrum when these required surgical intervention.

The President said that he saw many of these injuries in their early stages during the last war. He was convinced that they should be treated within the first twelve hours, by restoring the conditions to normal as much as possible, not forgetting the skeletal layer underneath and also the mucous membrane. The maxilla and mandible should be restored as far as possible with the belp of the dental surgeon.

In fractures of the nose, frequently one nasal bone was driven in and the other nasal bone driven outwards, and the replacement of the nasal bone driven outwards was forgotten. First of all the depressed nasal bone should be elevated, then the septum replaced, and finally the nasal bone which had been driven outwards should be pressed inwards. He agreed that a general anæsthetic should be used; these cases could not be manipulated effectively under local anæsthesia.

D. F. A. Neilson asked what was the best manner of dealing with an injury which involved the soft part of the nose. In one case he made a Stent splint for the patient to wear in the nose to try to establish the opening, but the patient took it out after two days and wore it at night for only about ten days.

What was to be done with fractures of the nasal bones where there was nothing more

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than the evidence of the X-rays for the displacement or fracture? In the case of the boy who had been injured in a game at school it was always a very difficult point to know whether to interfere.

When he had been called in to deal with an infected antrum due to injury he had always found the cases apparently do better after operation than was customary with infections of the sinus due to some ordinary cause. There might be some more basic physiological disturbance in the case of an ordinary sinus infection than in that of a sinus infection from trauma.

J. H. Otty said that in early cases it had been found surprisingly simple to reduce these fractures of the malar-maxillary region through the Caldwell-Luc approach. Many of these cases had considerable comminution of the orbital floor and of the posterior wall of the antrum. The displacement of the posterior wall of the antrum caused the patient considerable difficulty in opening the mouth. The comminuted orbital floor was easily moulded into position and then held there with a firm pack of "bipped" gauze. The end of the gauze was pulled out through the naso-antral opening and removed after ten days or so when a certain amount of consolidation had taken place. He asked whether Mr. Kilner had any experience of the use of refrigerated cartilage grafts preserved in merthiolate.

W. G. Scott-Brown said that in the treatment of adhesions in the nose, he had found it advantageous in getting grafts to take on the septum after division of adhesions to use wire cages on which to build up the Stent instead of putting in the Stent moulds. He exhibited a wire frame which was more usually made up as a cage. The discharges would escape through the framework and the graft could be left in position without being disturbed for a long period.

V. E. Negus (in reply) said that the remarks which Mr. Kilner had made about the use of the obturator applied equally well to operations on the upper jaw for malignant disease. It was sometimes necessary to remove the greater part of the maxilla. If the obturator was put in about the fifth day the soft tissues adapted themselves to the obturator instead of the obturator adapting itself to the soft tissues.

In reply T. P. Kilner said that in cases of nasal obstruction due to scar tissue free excision followed by the insertion of a skin graft on a mould was necessary. He fully approved of the contrivance which had been exhibited for retaining such a mould.

When there was any doubt about the diagnosis of fracture of the nose following an accident, confirmation should be obtained either by X-ray examination or by waiting until the subsidence of swelling made the deformity obvious.

He had never used refrigerated cartilage but there was ample evidence that it fulfilled its purpose of contour restoration satisfactorily. He thought that anything other than an autograft of cartilage tended to produce more reaction and was more liable to be replaced by fibrous tissue in the course of time.

He did not consider the presence of blood in the antrum in cases of malar fracture an indication for opening the antrum but he recognized the importance of ensuring intranasal drainage in cases in which the antrum had to be packed to support the comminuted walls of that cavity or when closure of fistulous openings was being undertaken.

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# Section of Otology

President-F. W. WATKYN-THOMAS, F.R.C.S.

[February 6, 1942]

# DISCUSSION ON SKIN DISEASES OF THE EAR

Dr. Reginald T. Brain: Infections of the external auditory meatus often produce secondary lesions in the path of the purulent discharge, and these lesions are unlikely to resolve until the otitis has cleared up. This is the task of the aural surgeon, and, because of anatomical factors, it is a difficult one, especially when orderna closes the meatal orifice.

The pus-coccal infections.—These are usually caused by streptococci and staphylococci, and clinically it is rarely possible to decide which organism is responsible. The pneumococcus may also give rise to similar lesions, and occasionally diphtheritic bacilli are

recovered instead of the expected pus-cocci.

Impetigo contagiosa may affect the ear. The common scabbed type of sore is easily recognized but bullous lesions also occur in erythema multiforme and in those grave mysterious diseases of pemphigus and dermatitis herpetiformis. In hydroa æstivale, vesicular and bullous lesions erupt on the ears, face and hands during the summer, and unless it is noticed that the lesions affect all parts exposed to light, the ear eruption may be mistaken for impetigo. Circinate impetigo often resembles tinea, but its course is more rapid and its colour deeper red. Impetigo pityroides, the scaly variety, is similar to seborrhæic Ulcerative lesions are rare in impetigo, and cultures should be made to find the causative organism. The skin folds are commonly involved in impetigo, and retroauricular intertrigo and septic fissures occurring under the lobule and in the fossa of the helix may be very resistant to treatment. From a moist lesion of impetigo, including intertrigo and fissures, a patchy pus-coccal dermatitis may spread to the face, neck or scalp. Treatment has a good deal to do with the cause and prevention of this variety of dermatitis. Follicular infection from staphylococcal impetigo may result in a boil, but it is surprising how often boils arise as primary lesions. In the Near East cutaneous leishmaniasis produces a similar lesion but chronic in its course. Certain individuals are very prone to staphylococcal infections, and the seborrhæic subject is a well-known dermatological type. Plump and placid or thin and nervous, the seborrhæic subject has a moist greasy skin, a liking for carbohydrate and fat, and a marked susceptibility of the skin and mucous membranes. Apparently the skin is attacked by the pityrosporon of Malassez, the benign bacillus abundantly found in scurf, for it is certain that many a scurfy scalp becomes inflamed and a scaly dermatitis spreads from it to the ears, face, and neck; also to the mid-line of the back and chest and to the folds and flexural surfaces. A retro-auricular intertrigo of seborrhœic origin is very common and is easy to recognize if the pale pink lesions covered by a flaky, soft, greasy scale are seen to be continuous with the scalp condition. Pus-coccal intertrigo has a deeper colour, and when it spreads into the scalp it does so asymmetrically, and the unaffected parts are not scurfy. seborrhæic lesions invade the auricle and external meatus and, if they are a part of the condition described above, the diagnosis is not in doubt. This suggests that seborrhæic dermatitis is a specific infection, but unfortunately the pathogenicity of the pityrosporon has not been established, and the scaly lesions of impetigo suggest that mild coccal infections produce similar lesions, so that seborrheeic dermatitis is still a controversial subject for dermatologists. So is eczema which is obtusely confused with dermatitis.

Dermatitis is surely an inflammation of the skin, having a cause and classical signs and symptoms. If the cause is removed the inflammation should subside. Frequent examples are met during the treatment of coccal and seborrhocic lesions when some application irritates the skin. The affected area becomes erythematous and odematous, and burns, and the exudate causing the odema may raise vesicles or blebs or ooze through the horny layer and make a moist surface. If this dermatitis venenata is recognized early and the causative irritant removed, the inflamed skin will soon respond to cooling lotions.

Eczema is a reaction peculiar to a hypersensitive skin, and the hypersensitivity can be inherited or acquired. In varying degrees most irritants can sensitize the skin, and if the eczematous reaction occurs while the skin is inflamed the eruption appears on an area of dermatitis which is then described as eczematous. The first essential feature of eczema is that when the cutaneous hypersensitivity has been established the cruptions are often

independent of external factors, or at least the irritating properties of those factors are imperceptible to the normal skin. The second essential feature is the morphology of the lesions. Eczema appears as grouped, minute papulo-vesicles set in non-inflamed skin. The vesicular character, microscopically constant, becomes obvious when slight scratching reveals a weeping spot. Itching is marked in the eruptive phase but subsides when weeping begins. The exudate dries into golden crusts or maintains a moist surface upon which the skin cocci flourish and produce a dermatitis sometimes obscuring the eczema. Since eczema is the reaction of a hypersensitive skin the appearance of the eruption is the call to suspend the use of active remedies and to apply bland lotions and emollients. General treatment with sedatives to allay irritation and to restrain scratching is important, and calcium and vitamins help to reduce the reactivity and permeability of the skin capillaries. Ultra-violet light has a good effect upon the skin, upon metabolism and upon the mental outlook of the patient.

The chronic infections of tuberculosis, syphilis, leprosy, yaws and leishmaniasis may attack the ear, and the granulomatous eruptions due to bromide or iodide are somewhat

similar in appearance to the lesions of these infections.

Lupus vulgaris more commonly affects the face than the ear, and can be recognized by its brownish-red translucent nodules which have a close resemblance to apple jelly when compressed under glass. This may be difficult to observe in the lobule, which often becomes reddened with congestion. Lupus vulgaris is an active tuberculosis of the skin leading to ulceration, and the lobule and a considerable part of the pinna may be destroyed. It also occurs in the purple congested lobules of patients with chilblains, and is then called lupus pernio. The sarcoid of Boeck shows similar lesions, and nodular infiltrations of the skin also occur in leukæmia and in Hodgkin's disease.

Lupus erythematosus is quite distinct from lupus vulgaris but its final atrophic phase results in just as much destruction of the pinna but without ulceration. The erythematous lesions are superficial and scaly and horny plugs mark the orifices of the sebaceous follicles. It is thought that lupus erythematosus is an allergic reaction to streptococcal or tuberculous infection and certainly the most dramatic cures result from the extirpation of a septic focus, usually found in the nose or throat. When a focus cannot be found, treatment with sulphanilamide or sulphapyridine gives a fair measure of success and some support to the view that the streptococcus is of ætiological importance.

Mycotic infections of the ear are rare and it is not proposed to discuss them. When they do occur perhaps the experience of the dermatologist with the common fungus diseases would be of value to the otologist.

The virus lesions of the skin are also rare, but they are not without interest. Herpes simplex and zoster are often confused and indeed if the eruptions are scanty it may be impossible to distinguish between them. Both have an eruption of grouped vesicles on an inflamed base and are unilateral. Zoster is the more painful and its eruption is often spread over the distribution of the cutaneous sensory nerves belonging to the ganglion attacked. The pinna is mainly involved with the adjacent parts of the face and neck when zoster attacks the second and third cervical ganglia and the extent of the eruption makes the diagnosis clear. Of greater interest and difficulty is zoster of the geniculate ganglion, for the sensory supply of the 7th nerve is somewhat rudimentary and overlaps that of adjacent nerves to the tympanic membrane, the external auditory meatus and the adjacent parts of the concha, so that a few vesicles in these inconspicuous sites or on the anterior part of the tongue may be the only direct evidence of zoster infection as the cause of facial palsy. In 1907 Ramsay Hunt [1] drew attention to these facts in his classical paper on "Herpetic Inflammations of the Geniculate Ganglion" and in 1933 Aitken and I [2] were able to confirm Ramsay Hunt's thesis by using a method of complement fixation for zoster which I had tound to be reliable [3]. The sera of 9 cases of Bell's palsy with zoster-like eruptions in the areas of the sensory supply of the geniculate ganglion were all found to contain antibodies to zoster virus while the sera of 22 cases of Bell's palsy without such eruptions had demonstrable antibodies to zoster in only four instances, or in less than 20%. Since evidence exists to support the view that symptomatic zoster, and herpes, are the result of the activation of latent virus by infection, trauma or shock, it is possible that the unexpected post-operative Bell's palsy is a zoster lesion even in the absence of a vesicular eruption. The possibility would be a probability if, after a few weeks, the presence of zoster antibodies could be demonstrated in the patient's serum. With good antigens the complement-fixation test for zoster is as reliable as the Wassermann reaction, but the test is rarely used outside a virus research laboratory.

Zoster should not be confused with herpes simplex. Zoster virus is probably a modified strain of varicella virus. Immunity after infection is usually solid and lasting, so that zoster rarely recurs. It is non-infective for the ordinary laboratory animals. On the other hand herpes is not related to zoster. Recurrent attacks are common and the rabbit and guinea-pig are readily infected.

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Warts and molluscum contagiosum may occur on the ear and their virus origin should be remembered because cure necessitates the destruction of every infected cell. The virus lesions of variola, varicella and vaccinia may be seen on the pinna and bromides and iodides produce good imitations of these lesions. The rare condition of painful nodular growth of the ear is of obscure actiology but its pathology is that of focal inflammation with necrosis of cartilage and a foreign body reaction, the epidermis being thickened above it. This chronic painful nodule develops upon the upper part of the helix and often makes the pressure of a hat or pillow unbearable. It will respond to some method of cauterization but rarely to other treatment.

The keratoses are interesting dermatological lesions and some varieties remain as obscure to dermatologists as keratosis obturans does to the otologists. Hyperkeratosis occurs in certain congenital abnormalities such as ichthyosis. It may be a functional disorder and is quite common after any severe erythema, whether that is due to local irritation or to infection, toxins or drugs. It is characteristic of seborrhœic dermatitis, psoriasis, pityriasis rubra and follicular lesions such as keratosis follicularis and keratosis pilaris. The latter condition and possibly some of the diffuse keratoses may be manifestations of vitamin A deficiency.

Senile keratoses are not uncommon on the helix and may be recognized as horny wart-like papules. Removal of the horny cap reveals a bleeding shallow crater with the raised and irregular features of an epithelioma. The histology is suggestive of a precancerous lesion in the early phase and eventually most senile keratoses develop into squamous-celled epitheliomata. Tar warts and actinic keratoses have a similar pathology and all these keratoses should be treated with radium or failing that, be destroyed by some form of cautery. In the congenital disease of xerodermia pigmentosa young subjects are very sensitive to sunlight and in consequence rapidly develop freckles, atrophic macules and actinic keratoses which become malignant. The natural prominence of the pinna exposes it to sunlight so that it is a common site for actinic lesions.

Rodent ulcers and the primary type of squamous-celled epitheliomata occur on the ear and, since invasion of the cartilage is almost inevitable, the prognosis is not so good as when the lesion is solely dermal, and disfigurement is common. Moreover cartilage reacts badly to irradiation, and a very painful necrosis with perforation sometimes follows:

Dermatological principles of treatment.—Treatment should be governed by two important facts. The first is that our protection from external irritants and infections depends upon a dry and intact horny layer, and treatment should be designed to maintain it. Pyogenic lesions are often spread by wet dressings or by ointments which retain sweat and exudates. The second fact of therapeutic importance is that living cells are instantly damaged by water or by grossly hypotonic solutions, and this applies to the skin when the protective stratum corneum is missing or its continuity is disrupted by exudation. Thus the washing of a weeping eczematous area with plain water is usually quickly followed by an increase of the irritation, erythema and exudation, and in consequence resort is made to the inferior procedure of cleansing with oil instead of trying isotonic solutions.

Before considering local applications in detail, thought should be given to the general condition of the patient and his or her reaction to the skin lesion. Eczema and lichen simplex are often manifestations of a neurosis and many a pus-cocal infection fails to clear up with proper treatment because the patient scratches. Reassurance and small doses of phenobarbitone make the difference between success and failure in such a case. Although it is obviously sensible to consider the patient's diet and to advise the use of protective foods, dermatologists have found few indications for rigid dieting. It would also appear that too much has been expected of the vitamins. Vitamin A has been used hopefully in the keratoses; vitamin B, for neurogenic and herpetiform lesions; vitamin C in the infections and to protect the capillaries; vitamin D for its effect upon calcium metabolism and so diminishing the irritability of, and the exudation from, capillary vessels; and nicotinic acid for its influence in desensitizing the skin to sunlight, and possibly as a factor in the resistance of nerve tissues to herpetic infections. Sulphonamide is very valuable when a pus-coccal lesion of the skin shows its virulence by a bright erythematous flare.

In the chronic staphylococcal infections small doses of thyroid and injections of collosal manganese or of manganese butyrate appear to be beneficial. Toxoid and vaccine constitute more rational therapy but often fail because the general immunity they undoubtedly confer does not influence the carrier state nor the susceptibility of the skin to the

staphylococcus.

Therapeutic agents in dermatology.—Of these, lotions are the most useful. Calamine lotion is well tolerated even by the eczematous skin and the addition of 2% phenol or 0.1% mercury perchloride gives it antiseptic qualities. To allay irritation 2% of tar solution

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or of strong solution of lead subacetate may be added and for seborrhæic dermatitis 2% of precipitated sulphur. A lotion with a powder basis adds to the debris of the meatus and this can be avoided by using simple solutions. Gentian violet, methyl violet, brilliant green or malachite green can be used in 1 or 2% solution in water. Acriflavine 0·1% in water has the advantage of not obscuring the skin lesion, and for exudative conditions 4% of tannic acid may be added. This lotion is useful for moist pus-coccal lesions and for eczema. The metallic salts are used when an astringent effect is indicated; they are antiseptics too but of a low order in the presence of exudate; they have little power of penetration unless ionized and idiosyncrasy towards them is not uncommon. Examples are: mercury perchloride 0.1%; l'eau d'Alibour which consists of zinc sulphate 6 gr., copper sulphate 4 gr., and camphor water to one ounce; silver nitrate 1-5% in distilled water is also useful.

When a quickly drying application is indicated a spirituous paint should be used, For example, the aniline dyes already mentioned can be dissolved in 50% industrial methylated spirit or 10 gr. of silver nitrate can be dissolved in 60 minims of distilled water and made up to one ounce with spirit of nitrous ether. Eczematous lesions are very intolerant of spirit which is painful unless the horny layer is intact but spirit paints penetrate the follicles better than watery lotions and are useful to localize boils.

A 5% sulphanilamide solution in glycerin is a useful paint for crusted pus-coccal lesions and as a dressing for septic ulcers. Powders are used to dry up exudates and to limit infections of the skin, and powdered sulphanilamide is certain to prove of value in the treatment of meatal lesions. Bismuth subgallate is another useful astringent powder and 5% of calomel may be added to it as an antiseptic or added to a zinc oxide and tale

When lotions are not tolerated or when the skin becomes too dry and tends to crack,

creams or pastes are indicated.

The simplest cream consists of equal parts of a vegetable oil and lime water with perhaps 5-12% of hydrous lanolin to make it more stable. 5 or 10% of zinc oxide or calamine added to this emulsion makes a zinc or calamine cream which may be medicated with 2% each of phenol, tar solution, ichthyol or sulphur; the latter being of service in seborrhæic dermatitis. A paste should contain equal parts of powder and grease: for example zinc paste consists of starch 25%, zinc oxide 25% and vaseline 50% and to this may be added 2% of salicylic acid, or 3% of coal tar or of yellow oxide of mercury and similar percentages of ichthammol, resorcin or sulphur are used for schorrhocic lesions. Pastes with their high content of powder can absorb water and lose it, so that the skin surface is drier and cooler than when it is covered by ointment. Besides this therapeutic gain the saving of 50% of the fatty base is a valuable economy in war.

Ointments are made with bases of vegetable and animal fats with the addition of hard and soft paraffin or of the latter alone as a base. Recent advances have been made with new emulsifying bases which are less greasy and bring the active ingredients into more intimate contact with the tissues. These new bases are readily miscible with water and so are much more easily cleansed from the skin. Comment has been made upon the limited use of ointments in dermatology, and no reference need be made to those in common use. Ointments containing sulphanilamide are certainly potent on streptococcal lesions of the skin and quinolor ointment is often very effective on staphylococcal lesions. So little of these ointments is required for an individual patient that there can be no

objection to using a proprietary preparation.

Since seborrhæic lesions of the ear usually resist treatment or soon recur unless the scurfy condition of the scalp is cleared up, here are a few hints on the treatment of the scalp. For a dry scurfy scalp an ointment of 3% precipitated sulphur and salicylic acid should be rubbed in at night and shampooed out after a day or two with sulphur soap and weak sodium carbonate solution. Instead of the ointment a liniment of salicylic acid 25 gr., industrial methylated spirit I drachm and castor oil to one ounce may be preferred. 5% of phenol or of liquor picis carbonis may be added to the ointment or to the liniment to allay irritation. When the scurf has been cleared relapse may be prevented by the continued use of a lotion such as: resorcin 10 gr., industrial methylated spirit 2 drachms and liquor hydrarg, perchlor, to one ounce. If this proves to be too drying 20 minims of castor oil or of glycerin should be added to each ounce. Weekly shampoos are indicated in subjects prone to pityriasis capitis or seborrhæa.

Physiotherapy.—Otologists are familiar with methods of ionization and are no doubt aware that although the penetration of ions is slight the surface effect of the solutions employed is greatly intensified. In consequence eczematous lesions are usually aggravated by ionization. Although lesions of the meatus can be treated with local ultra-violet light by quartz applicators and a Kromayer lamp the greater beneficial effect of general ultraviolet ray therapy in chronic infections is often unsought. It is not generally realized

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that a drying source of heat is most comfortable and healing in the treatment of boils, and use should be made of infra-red rays, diathermy or X-rays. The last-mentioned in fractional doses is of the greatest service in many chronic skin diseases of the ear and it is unnecessary and less effective to attempt to restrict the irradiation to the meatal walls. Radium and radon are invaluable agents in the treatment of the senile and actinic keratoses and of the epitheliomata.

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The President asked, with regard to allergic reactions, could a patient become sensitized to preparations commonly employed? He had noticed that a patient would do well for a time on one particular preparation and then suddenly get worse. Was that true of mercury and sulphur?

The abuse of peroxide was responsible for many of their troubles. Patients with discharge were too often sent away, week after week, with peroxide drops. Could peroxide set up a chronic dermatitis?

As to zoster lesions, the complement-fixation test should establish the diagnosis in doubtful cases of Bell's palsy between the true palsy a frigore and a missed zoster.

Lastly, in keratosis obturans. Was this a true keratosis or was it a cholesteatoma which had burst its way through and so dilated the cavity?

Mr. R. J. Cann said that he had occasionally met a condition which he had not seen described. The patient complained of a chronic discharge, with possibly a history of bleeding, and after cleaning out the meatus there was seen on the deepest part of the walls of the meatus or even on the membrane, patches of granulation which bled when touched. Apart from the granulations the membrane was seen to be intact. One or two applications of a caustic to each of the granulations would clear the condition up in a week or a fortnight. He did not know the pathology.

Dr. Hugo Frey said that he was glad to hear Dr. Brain attribute importance to the mental condition of the patient because he had also come to the conclusion that in a number of cases eczema or dermatitis was only secondary to itching sensations of nervous or psychic origin. Itching in the meatus was very common. It was known that the Chinese were accustomed to carry about with them a small instrument for the purpose of scratching

Another reason for the eczema was possibly an over-indulgence in personal cleanliness. There was a general idea that the meatus must be most thoroughly washed, and he had seen even nurses and mothers continually trying to cleanse babies' ears, and this was frequently the cause of eczema. The complete removal of cerumen might make the skin of the meatus too dry, and so produce the itching. Many ointments and oily compositions were dangerous and likely to make an existing eczema even worse.

For local treatment in acute cases resorcin solution 1%-2% seemed to be very efficient.

Mr. F. C. Ormerod said that amongst civilians the most frequent type of external ear disease was an eczematous condition associated with seborrhoic dermatitis.

There were, after the last war, many soldiers and other service men who required treatment for a chronic thickening of the skin of the meatus. The meatus was found to be almost impervious to anything but a small probe. It was assumed that most of these men had chronic middle-ear suppuration, although in many cases the drum head was hever seen.

During the last two years he had seen many young soldiers with a similar condition in a much earlier and more acute state. He did not think the condition was one of seborrhæic dermatitis, but most of them had infection of the tonsils. They often required several weeks of treatment. He felt that there must be many more people in the Forces with conditions of this kind, and that there was great danger of chronic external otitis resulting under Army conditions. It would be interesting to learn whether the members in the medical services were having much trouble from this external otitis.

Lieut.-Colonel M. L. Formby said these cases caused much trouble in the Army. Difficulties had arisen firstly because from 1937 onwards men were accepted into the Army with discharging ears, and secondly when civilian medical boards were introduced in 1939 no instructions were issued regarding otitis externa. In future chronic cases would not be admitted. The present problem was the large number already in, many of whom had now become extremely useful soldiers. If possible these men must be retained. Many lost a great deal of time attending sick parades and having treatment, others spent

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a considerable time in hospital. The aim now was to investigate the cases in the Army, co-operating with dermatologists, in an endeavour to ascertain their nature, whether seborrhœa, eczema, &c., and to treat on appropriate lines. From now on instructions to civilian medical boards would be that these cases should be sent for an otologist's opinion before they were accepted.

Men in the Army with chronic otitis externa for which no definite cause could be found and in whom treatment was unsuccessful would be boarded out unless they were extremely useful persons whom it was desirable to retain.

One Army otologist had taken a great interest in otitis externa and had been struck by its association with dental trouble, particularly impacted wisdom teeth. He had been encouraged to collect these cases and publish findings.

Dr. Agnes Savill mentioned the case of a man who had suffered for four years with a condition of infective eczematoid dermatitis of the ears, with blocked auditory canal and much cedematous swelling of the whole ear. Ionization given deep down into the canal with zinc, and then salicylic acid, had effected a cure in about six weeks.

A simple remedy for dandruff of the scalp consisted of half to one dram of liq. carbonis detergens to the ounce of water.

Lieut.-Colonel Mitchell-Heggs supported Dr. Brain and others in their views on the importance of the treatment of septic foci in certain cases and the value of post-operative rest and adequate diet, especially for those patients who relapsed after apparent recovery following an effective local application such as that of a weak silver nitrate lotion. He mentioned the importance of bacteriological examination and recalled a case of B. pyocyaneus infection of the meatus successfully treated by Major Philip Scott. He also recalled a case of recurrent pruritus and dermatitis which responded well to general treatment for gout, and stressed the importance of keeping hair away from the pinna and avoiding hats which compress the ears in women suffering from active or convalescent dermatitis of the pinna with a sensitive ticklish skin.

**Mr. W. Stirk Adams** said that he also had seen the granulations on the drumhead associated with a discharge; he had regarded it as a secondary condition, but he agreed with Mr. Cann. As to chronic otitis externa affecting the deep meatus, it was a difficult condition, and the most successful treatment was 5% silver nitrate in aqueous solution. The patient was also asked to use 2% nitrate of silver drops daily for about a fortnight, and after that to keep it by for use at longer intervals. Generally the condition cleared up after two or three weeks' treatment.

Mr. R. D. Owen asked Dr. Brain for his opinion as to the use of the "wet" or the "dry" treatment in patients with chronic eczematous meatitis; in other words the use of drops as compared with powders.

Dr. Reginald T. Brain in reply said that the skin could be sensitized by simple chemical substances but this was not common with the preparations usually employed. Mercury and sulphur were irritants and dermatitis was often seen after their use. He had never seen a case of dermatitis which could be attributed to hydrogen peroxide but cases had been reported by Sabouraud. Probably the continual wetting was the main factor but the protective horny layer would undoubtedly suffer mechanically and by oxidation from peroxide.

He was in entire agreement with Dr. Frey's remarks and several types of prurigo were recognized by dermatologists in which the skin lesions, usually eczema or lichen simplex, were the result of scratching. A common site for this neurogenic lichen was just behind

With regard to the "wet" or "dry" treatment of chronic eczematous meatitis the continued and casual use of ear-drops by a patient was bad for the skin. An ordematous skin was usually aggravated by moisture and in dermatological practice drying lotions and paints would be used. Since the meatus was badly ventilated it must be carefully dried by expert swabbing or by a warm jet of air. Powders might be useful in the terminal phase but they formed concretions with exudate; an obvious disadvantage. In conclusion Dr. Brain paid tribute to his teacher, Dr. J. H. Sequeira and to Professor S. P. Bedson for help in researches upon virus diseases of the skin.

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# Section of Neurology

President—George Riddoch, M.D.

[February 19, 1942]

## DISCUSSION ON CEREBRAL ŒDEMA

Dr. J. G. Greenfield: Criteria of Cerebral Œdema.

Three criteria have been suggested so far. These are (a) physical, (b) chemical, (c) histological.

(a) The physical criterion rests on the relationship between brain size and skull capacity, Following Rieger and Reichardt, Alexander and Looney define cerebral œdema as an increase of brain size beyond 96% of skull capacity. This is satisfactory except for the difficulties of the technique of measurement and the possibility of vascular dilatation. The normal variations associated with age also introduce an error of unknown dimensions. In childhood, as is well known, the brain fills the skull almost completely; in old age the vertex is separated from the bone by a varying depth of subarachnoid space; and the disproportion between skull capacity and brain size varies with different people at the different age-periods. Le Beau (1938) has simplified this definition by using tentorial herniation as the criterion of cerebral œdema.

(b) The chemical criteria depend on the ratio of wet to dry weight of the brain substance. Much work which has been done on this question has not taken into account the normal difference between grey and white matter in this respect although this was established by Halliburton in 1894. Normally about 70% of white matter and 83% of grey matter consists of water and as cedema is rarely sufficiently intense to add more than 10% of water to the brain tissue, it is necessary to examine grey and white matter separately in making this analysis. Stewart-Wallace (1939) added the valuable criteria of the contents of sodium and chlorine ions, since the fluid added to the swollen brain tissue brings with it sodium chloride in a concentration at least as high as in blood plasma. Owing to the virtual absence of chlorine from the nervous tissues the percentage increase of chlorine ions is especially great, rising to 500% or even 600% of the normal. That of sodium may rise to 200% and rarely to 300%. These figures should be corrected for added blood by the determination of excess of iron, as has been done by Shapiro and Jackson (1939), and this is especially important in examining the grey matter. Even with this correction the figures do not reveal whether water and sodium chloride are added to normal brain tissue or merely fill the spaces left by atrophy of cerebral tissue, as Alexander and Looney (1938) have shown that they do in senile and shrunken brains. The method is, however, of value in cerebral tumours in which ædema is usually confined to the homolateral side.

(c) Histological criteria of cedema have been denied by many, though certain histological changes have long been known to occur in the more severe forms. The false distinction between cerebral cedema and simple swelling of the brain has for long confused thought and delayed progress in this direction. At the present time, we can define the histological characteristics of cerebral cedema in the white matter only, and again only in the forms related to cerebral tumours, granulomas, and abscesses. In such lesions we can form some opinion also of the severity and duration of the cedema on histological grounds alone, but we may be unable to tell whether an old-standing lesion has resulted from cedema or from some other cause.

If it were possible in any given case to apply all these criteria the diagnosis of cerebral ædema would be certain. Actually with any two of them in agreement the diagnosis is reasonably definite. But many conditions have been described as ædema in which there is no further evidence than an increase in size of the brain in relation to the capacity of the skull, that is to say flattening of convolutions or tentorial herniation. Many of these are probably susceptible of a different explanation.

## Conditions Associated with Cerebral Œdema

(1) Of the known causes of cerebral cedema probably the commonest is thrombosis of cerebral vessels. It has long been recognized that brain tissue swells when its arterial

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blood supply is cut off or its venous drainage blocked. The cause of this phenomenon is not fully understood. In the grey matter the swelling is probably chiefly due to congestion of capillaries, at least in the early stages, during which this tissue looks redder than normal. But white matter which is swollen as the result of ischæmia does not differ appreciably in colour from the normal, and blood-vessels form so small a part of its bulk that any distension of these, without hæmorrhage, could not cause the great swelling which occurs. The swelling appears to be due to chemical changes in the myelin and axons and to be allied to the post-mortem swelling of these tissues. It seems to be a true ædema in the sense that the water content of the white matter increases. The histological changes in this form of ædema in its milder grades are similar to those in the severer grades of ædema surrounding cerebral tumours. The importance of cerebral ischæmia as a cause of ædema is twofold. It explains swelling of the brain in some cases of hypertensive encephalopathy, and in some cases of cerebral contusion in which thrombosis of cerebral vessels occurs. And it offers a possible theory for the ædema which occurs in relation to cerebral tumours.

(2) Cerebral tumours, granulomas and abscesses.—Much work has lately been done on cedema in relation to cerebral tumours. Here the first criterion of brain swelling (i.e. relationship of brain size to skull capacity) cannot be applied. But the fact that in most cases ordema is limited to, or is greater in, one hemisphere, makes it possible to apply the second and third criteria with the normal hemisphere as a control. As regards histological criteria, Spielmeyer, Spatz (1929) and others in Germany described swelling and degenerative changes in the astrocytes (clasmato-dendrosis and amœboid glia) in the cedematous area round cerebral tumours. But they regarded these as chance accompaniments and not, as I have lately shown, as one of the most constant and characteristic They paid little attention to the alterations in the nerve fibres and myelin sheaths, regarding these as simply separated from one another by interstitial fluid. Jaburek (1936) made a very important contribution to this subject. He found that ædema associated with cerebral tumours affects the white matter exclusively, usually only on the side of the tumour, and that it spares the large commissural tracts such as the corpus callosum, optic radiations and anterior commissure. He considered that the brain-stem was also spared but of this I have no confirmation. It certainly is not affected in tumours of the hemispheres. He also noticed that cedema is much more common in rapidly growing, poorly differentiated tumours, than in slow-growing gliomas, endotheliomas and angiomas. He could find no sharp distinction between cerebral ædema and brain swelling, which he considered to be merely two stages of the same process. Scheinker (1938, 1941) noted swelling of myelin and of axis cylinders as well as swelling of astrocytes in ædematous areas. He, however, still adheres to the distinction between ædema and swelling of the brain. I was able to confirm the observations of Jaburek and most of those of Scheinker in 1939. I did not, however, find in any of my cases the dilatation of perivascular spaces described by these authors. This may have been due to differences in technique, but it is remarkable that even when the myélinated fibres are widely separated by fluid the perivascular spaces appear closed. Swelling and pallor of the myelin sheaths were constant and irregular swellings on the axis cylinders were common in my cases. Every astrocyte in an adematous area shows swelling of the cell body, slight at first, and irregular in the more acute cases, whereas large fibre-forming astrocytes are seen in the more chronic cases. Mitoses in astrocytes is not a very uncommon finding in fairly acute cases, and many of the cells are binucleated. In contrast to the astrocytes the oligodendroglia showed little change, and the mobilization of the microglia appeared to depend on the changes in the myelin. As regards the distribution of the cedema, it always has an indefinite border, merging gradually with the neighbouring normal tissue. The escape of the subcortical arcuate fibres and of the corpus callosum and optic radiations was very striking in many of my cases. In some cases changes similar to those of ischæmia were found in the overlying cortex, but these were never very severe, and the cortex for the most part appeared normal. If therefore ædema in cases of cerebral tumour is due to ischæmia, the rich capillary network of the cortex must be able to supply it with oxygen.

In cases of abscess, tuberculoma and gumma of the brain, ædema is often very severe. To some extent it has the same histological appearances as the ædema surrounding cerebral tumours, but its inflammatory nature is shown by the escape of leucocytes from the vessels, and the more severe degenerative changes in the nervous tissues. Such changes are still more marked in diffuse septic encephalitis. This is a true inflammatory ædema.

#### Trauma of the Brain

In trauma of the brain cedema has been regarded as an important complication, so important in fact that for some years in many American clinics the treatment of cerebral

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contusion has been the treatment of the ædema which is supposed to follow the trauma. But the experimental and post-mortem investigations which have been made in the United States are definitely against this assumption. Probably it was Apfelbach's work (1922) that formed the basis for the American belief in traumatic ædema. He determined the ratio between wet and dry weight in brains of patients dying after cerebral trauma and found an increase of water in some cases up to 3.7%, although in many cases there was no increase at all. He concluded that ædema frequently occurs when the cranial bones are fractured and that it is most common in patients dying more than a few hours and less than three days after the accident, rarely earlier or later. But as he used an undetermined mixture of grey and white matter his results are worthless.

Nevertheless much clinical treatment continues to be based on the assumption that traumatic cerebral ædema is a major danger to life. Pathological investigations on the other hand have provided very little basis for this assumption. For example, Vance (1927) reviewed 512 cases of death from head injury. He found that during the first few hours there was an increase of intracranial pressure, with flattened convolutions. At this stage the blood-vessels were engorged. Later, twelve to twenty-four hours after the injury, there was distinct swelling of the brain and the brain tissue was moist, but he says: "No case presented the degree of swelling that Apfelbach mentioned and no example of death arising solely from this condition was found." Connor and Wright (1934) reviewed 1,760 clinical cases of cranial and intracerebral injuries with many autopsies. They could not find a single instance of generalized traumatic ædema coming on forty-eight hours after the injury. They say: "We are also somewhat sceptical of its late occurrence as we have never seen it." Shapiro and Jackson (1939) reported some investigations on cerebral ædema. Among other things they investigated the relationship of wet to dry weight, in grey and white matter separately, correcting for blood by estimating the iron content. Contrary to Apfelbach they found that injured brains contained less water but more blood than normal brains. They thus could find no evidence for true cerebral ædema after trauma.

Valuable experimental work on this subject was published by Pilcher (1937), who performed 60 experiments on dogs, allowing a weight of a half or one kilogramme to fall on the heads from a height of 5 feet. In no case did he produce either fracture of the skull or intracranial hæmorrhage, and only one dog died as a result of the trauma. Examination of the intracranial pressure showed a sharp initial rise after the trauma followed by a return to normal within thirty minutes. A subsequent more sustained rise of pressure began in some of the dogs one to two hours after the trauma. Examination of the brains at various intervals after the injury showed a slight increase in water in the grey matter, and an increase of not more than 2% of water in the white matter. These ratios were not corrected for added blood. A matter of some clinical interest in these experiments is that in dogs treated by intravenous injections of hypertonic dextrose the increase in the ratio of wet to dry weight was at least as great as in untreated dogs. He concluded that there was, after trauma, an increase of fluid in the grey matter, but he did not find any evidence that marked cerebral ædema occurred. As he did not correct his figures for added blood, by estimation of the iron, the increase of fluid in the cortex might well have been due to vascular congestion.

My own investigations in the matter have been histological. In the 31 traumatized brains which I have so far examined since the outbreak of war I have found no evidence of generalized post-traumatic cedema. Where the brain is bruised, especially after fracture of the skull, or where it is penetrated by a missile there is often a zone in which the myelin stains poorly, and the astrocytes are swollen. The ill-defined margin of this area and its demarcation by the subcortical arcuate fibres resemble what is seen in cedema round tumours. This zone may be a few centimetres in width, but rarely more than 2 cm. unless there is gross displacement of the bones of the skull with overriding of one

fragment by another.

In three cases a fairly large artery had become thrombosed and this had produced an area of degeneration of myelin, more intense in character and with much sharper edges than that due to cedema of the brain. This would have been associated with temporary

swelling of the tissues in the affected area.

These investigations lead me to conclude that cedema following injury to the brain is limited to the neighbourhood of the bruised area. Its extent appears to be related to the amount of deformity of the skull caused by the accident, and it is only great when fairly large fragments of skull are driven inwards and when there is overriding of the edges of the fracture. Even in such cases it usually only affects one pole. Naturally sepsis or abscess will increase its extent and severity. But apart from these complications it is usually very slight and is limited to the white matter underlying the bruised area of cortex.

Other causes.—As regards other supposed causes of cerebral ædema we are on very uncertain ground and I shall therefore refer to them briefly. Uræmia is often said to cause cedema of the brain, but I have no first-hand evidence for this. In hypertensive states the well-known encephalopathy is probably due primarily to foci of ischæmia and any swelling that may follow is of the nature of ischæmic cerebral softening. interpretation at least appears to be warranted by the histological changes which I have found in such cases. Alexander and Looney's cases of uramia and hypertension gave inconclusive evidence. They had three cases with this diagnosis in which there was an increase in the ratio of brain size to skull capacity. One of these had a subarachnoid hæmorrhage and one a hæmorrhagic softening in one occipital lobe. The latter was the only case in their series in which there was cedema of the white matter, as judged by the ratio of wet to dry weight of the tissue. Another case, that of a woman of 44, showed only 1.15% difference between skull capacity and brain weight, but the ratio of wet to dry weight of the brain tissue was reduced rather than increased.

Cerebral cedema has also been described in catatonia, and narcotic poisoning (Struwe, 1931), but more evidence is needed on these conditions. One condition, however, deserves mention, i.e. the swelling of the white matter of the brain which may occur in hydrocephalus, especially when it comes on rapidly. This is not a true cedema, but rather a passage of cerebrospinal fluid from the ventricles into the brain tissue through the stretched ependyma. The formation of diverticula of the ventricles into the surrounding white matter which has been described by Northfield and Russell (1939) appears to be a later result of this process. This condition has little clinical significance, as there is no

increase of the contents of the skull except that of cerebrospinal fluid.

In closing I would urge the need of clarity in defining cerebral ædema. Neither congestion of the cortex, nor wetness of the surface of the brain need have anything to do with œdema. The œdematous brain, when cut, may appear wet, but does not always do so, and post-mortem changes may simulate cedema macroscopically. In fact the only certain criterion of cedema, on examination of the fresh brain post mortem, is diffuse yellowish discoloration of the white matter and this is seen only in the severer grades of œdema.

Since cerebral thrombosis ranks high among the causes of œdema, we should bear it in mind where there is rapid increase of intracranial pressure in such conditions as uræmia, cerebral contusion, and after operation for cerebral tumours.

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Major W. Ritchie Russell: In attempting to determine the clinical results of cerebral cedema attention may be directed first to diseases which cause a general cerebral cedema and secondly to those conditions which cause local swelling of part of the brain.

In cases of uræmia for example there is some general ædema but the relationship of this to the comatose condition of the patient is unknown. In some cases of head injury there is a moderate degree of general swelling of the brain but there is no satisfactory evidence which supports the common belief that this is a cause of the associated disorders of consciousness. This ædema will, however, contribute to the slightest increase of intracranial pressure which is often demonstrated in the early days after injury. The remarkable bradycardia (Russell, 1934) which often continues for two or three weeks during recovery from closed head injuries may also be due to an cedematous condition of the brain or brain-stem, but the spinal fluid pressure in these cases may be quite normal, and it is important to note that this post-concussional bradycardia is not necessarily associated with impairment of consciousness.

The most definite example of local cerebral cedema occurs in the type of case studied by Greenfield (1939) in which a tumour or abscess involving one cerebral hemisphere

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is associated with gross swelling of all parts of that half of the cerebrum. An abscess of the frontal lobe may clinically cause hemiplegia which quickly clears up after the abscess is aspirated, and a comparable improvement in local signs is sometimes observed after a brain tumour is decompressed. These well-known clinical observations suggest that the improvement observed depends on the relief of circulatory embarrassment of which ædema is the most visible expression.

The effect produced by obstructing a cerebral vein may also throw light on the subject. Symonds (1940) has described the transient but widespread loss of function which follows thrombosis of a cerebral vein, while Mr. Pennybacker tells me that if a cerebral vein from the frontal lobe to the superior sagittal sinus is ligatured at operation there may be widespread loss of function of one cerebral hemisphere which temporarily causes hemiplegia, but from which there is a good recovery.

A recent operation provides a further example of the effects of obstructing a cerebral vein. An aircraftsman developed signs of increased intracranial pressure two months after being momentarily knocked out at boxing. At operation a large subdural hæmatoma was evacuated from the left side. The right hemisphere was then explored through a burr-hole high up in the right posterior parietal region: a large vein which presented beneath the dura looked so like the wall of a blood cyst that it was deliberately opened. The mistake being then appreciated, hæmorrhage was controlled with a muscle graft, but some swelling of the underlying brain was noted. On the day following operation in addition to there being complete astereognosis and some paresis of the left hand there was complete left homonymous hemianopia. The visual fields recovered in two or three days while stereognostic sense recovered almost completely in about three weeks.

In head injuries, areas of contusion or hæmorrhage are also surrounded by an area of ædema which may contribute to the transient hemiplegia frequently observed after local cerebral contusion.

All these examples of local circulatory disturbance have this in common, that they are associated with a local disturbance of cerebral function which is under certain circumstances only temporary. It is impossible, however, to conclude that the ædema in itself is the cause of the loss of function as other associated circulatory abnormalities may in fact be more important.

Recent experiments on cats by Denny-Brown and Russell (1941) on what we termed acceleration concussion contributed little to this problem. We found that in the absence of gross intracranial hæmorrhage there was no important change in intracranial pressure or other evidence of cedema after severe concussion.

It is an interesting practical question whether local cedema surrounding a tumour or abscess is readily influenced by intravenous hypertonic solutions or whether the brain shrinkage observed in these circumstances is due more to a reduction in volume of the relatively normal brain tissue. If the cedema in these cases is due simply to venous obstruction it is difficult to see how an intravenous hypertonic solution can readily influence the edematous area. It is possible therefore that these dehydrating measures affect the relatively normal brain to a greater degree than the abnormal edematous brain. This hypothesis would give some explanation for the disappointing results and the delayed relapses which may follow this form of treatment.

We have attempted to investigate this matter by observing the effects of injecting 50 c.c. of 50% sucrose intravenously following air encephalography or ventriculography in cases of ventricular displacement due to cerebral tumour. Radiological examination of the air-filled ventricles was repeated at intervals of up to half an hour following the intravenous infusion. No significant change in the position of the ventricular system was, however, demonstrated, but we have no evidence that the few cases investigated were in fact complicated by cerebral cedema of marked degree.

In conclusion, therefore, while it seems evident that local cerebral cedema is associated in pathological conditions with loss of cerebral function of the ædematous area, it does not seem possible with our present knowledge to decide whether this local abnormality is in fact due to the cedema or is due to other circulatory disorders with which the primary condition is associated. There is a danger that the diagnosis of cerebral ædema is

used as a cloak to conceal our ignorance of the cause of certain cerebral states.

I am indebted to Lieut.-Colonel G. O. Chambers, M.C., R.A.M.C., for permission to refer to cases in the hospital under his command, and to my colleagues for assistance.

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# An Investigation into the Effect of Intravenous Injections of Sucrose on the Cerebrospinal Fluid Pressure as Measured by Lumbar Puncture

By J. Hamilton Paterson, M.B., B.S.

Though the use of concentrated solutions of sucrose administered by intravenous injection for the purpose of effecting a reduction in intracranial pressure has been frequently practised in many neurosurgical units during recent years, it has been felt desirable to inquire more fully into the degree of actual reduction of intracranial pressure so obtained. The effect of sucrose thus administered was therefore investigated in a small series of cases with normal and with raised intracranial pressures by means of a continuous recording apparatus. A standard quantity and concentration of hypertonic sucrose solution—namely 100 c.c. of a 50% solution—was used in all but two cases.

Two methods of performing such an investigation were open to choice, the simpler being repeated lumbar puncture, performed before and after the injection, the cerebrospinal fluid pressure being measured on each occasion. We felt that this method was open to the grave objection that cerebrospinal fluid has been shown to leak from the initial puncture hole in the theca, a fact which has been noted on several occasions by other observers. This leakage has occurred in our own experience and is well illustrated by the following record (fig. 1).

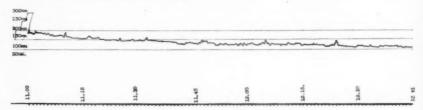


FIG. 1.—High pressure. ? Thecal leakage.

A continuous record was attempted, but owing to difficulties in obtaining a satisfactory record, the lumbar puncture needle, the point of which had been in the subarachnoid space, was removed and reinserted. A steady decline in pressure resulted, which could only be reasonably attributed to fluid leaking through the theca from the initial puncture hole.

The other available method is to insert a lumbar puncture needle into the spinal theca in the usual way and, after attaching a suitable manometer, to strap the apparatus securely to the subject for the duration of the investigation. Readings of the cerebrospinal fluid pressure can then be made at regular intervals both before and after the injection of sucrose. This method was the one we employed in earlier experiments. It was found, however, that in many cases the normal fluctuations in the manometer level accompanying the slightest movement on the part of the patient, as well as the respiratory excursions, rendered accurate readings impossible. A recording apparatus was accordingly devised which not only gave a continuous graphic representation of the cerebrospinal fluid pressure, but effectively damped down such extraneous fluctuations in pressure.

This recording apparatus connects the lumbar puncture needle through pressure tubing with a vertical glass tube of medium calibre connected with an air tambour which actuates an inkwriting pen recording on a slowly moving drum. The whole length of rubber tubing and the lower part of the glass tube is filled with normal saline which thus transmits the pressure of the cerebrospinal fluid to the air in the upper part of the glass tube and in the tambour. It should be noted that considerable changes in the pressure can thus be recorded without the displacement of more than one or two cubic centimetres of cerebrospinal fluid. For convenience in calibrating the records, a T-piece is fitted in the pressure tubing connected to a saline container which can be raised or lowered to the requisite level and put in communication with the rest of the system by opening a cock. In calibrating the record the level of saline in the glass tube (and consequently the pressure in the tambour) can be controlled against the centimetre rule alongside the glass tube, the zero level of which is set to the level of the lumbar puncture needle.

The lumbar puncture needle used is fitted with a 3-way tap and vertical bayonet mount carrying a rigid glass manometer.

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To set up the apparatus the lumbar puncture needle is introduced into the subject, who reclines on his side with the head on the same level as the lumbar spine. Patients have been found to tolerate this procedure quite well for periods up to six hours. The apparatus is then filled with sterile normal saline and is connected to the lumbar puncture needle which is firmly strapped to the subject's back. After calibration of the system the tap on the needle is opened and the recording drum is started.

Blood-pressure and pulse readings are taken every quarter of an hour. A sufficient time is allowed to elapse for a satisfactory basic level of lumbar cerebrospinal fluid pressure to be established—usually a period of about an hour—after which the injection of 100 c.c. of 50% sucrose solution is given intravenously. Continuous records of the lumbar cerebrospinal fluid pressure are made over periods up to three and a half hours following the injection.

## Controls

Adequate controls of the apparatus without the injection of sucrose were carried out in ten subjects with a normal and nine with a raised intracranial pressure. Typical tracings from controls with normal pressure are shown in fig. 2.

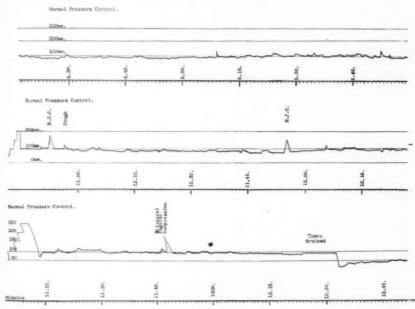


FIG. 2.

The cerebrospinal fluid pressure was steadily maintained and the recording apparatus was quite sensitive, the tambour quickly responding to sudden transient rises in pressure produced by coughing or by jugular compression.

Figure 3 shows three similar tracings from high pressure controls.

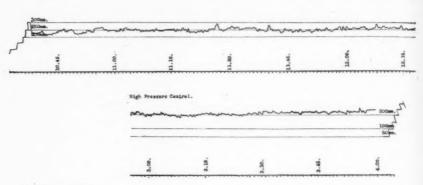
### Sucrose Injection. Normal Pressure Subjects

The effect of an injection of sucrose on eight subjects with a normal cerebrospinal fluid pressure—i.e. below 150 mm. of water—was next investigated, seven of the subjects receiving 100 c.c. of 50% sucrose solution, the eighth receiving only 50 c.c.

A definite reduction in pressure was obtained in four of these cases, the maximum effect being a reduction in pressure of 30 mm. of cerebrospinal fluid which, maximal in fifteen minutes, was maintained for only one hour. In each of the other three cases showing a reduction in pressure, a fall equivalent to 25 mm. of water was obtained in ten to fifteen minutes but which lasted only from one to two and a half hours. The case receiving only 50 c.c. of sucrose showed but a transient and negligible reduction in pressure.

Three typical tracings from records are shown in fig. 4, the uppermost being a

High Pressure Captrol.



Bigh Pressure Control.

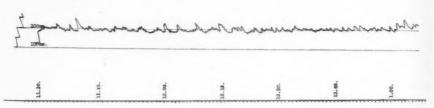


FIG. 3.

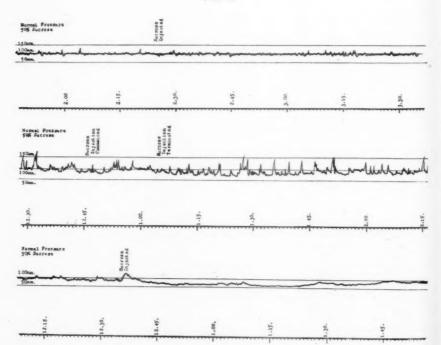


FIG. 4.

case in which no effect was obtained; the middle showing a reduction in pressure of about 25 mm. water; whilst the lowermost illustrates the maximum effect obtained of 30 mm. water.

## Sucrose Injection. High Pressure Subjects

Finally the effect of sucrose on eight cases with a raised cerebrospinal fluid pressure was investigated, seven subjects receiving 100 c.c. of 50% sucrose solution, the eighth receiving 50 c.c. only.

A definite reduction in cerebrospinal fluid pressure was obtained in five cases, whilst in three cases despite initial pressures ranging from 200-300 mm. water, no effect was obtained. The maximum reduction in pressure which occurred was obtained in a subject with an initial pressure of 420-440 mm. water; a quarter of an hour after injection of sucrose the pressure had dropped to 380 mm., but in fifty minutes the pressure had risen to 480 mm.

Another case with an initial pressure of 200-210 mm, showed a reduction in pressure after sucrose injection to 170 mm., maintained for two and a half hours. In the other three cases in which an effect was observed, reductions in pressure of 20-30 mm, occurred in fifteen to twenty minutes lasting from fifteen minutes to two hours. This last group included the subject who received only 50 c.c. of sucrose solution.

The three tracings (fig. 5) illustrate typical effects obtained in high pressure cases

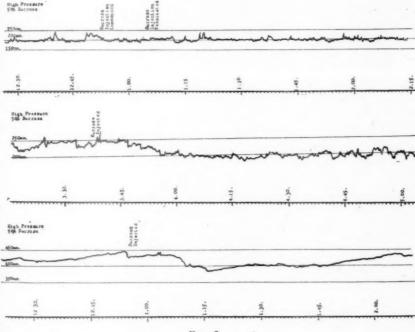


FIG. 5.

after injection of sucrose, the uppermost tracing showing no effect, the middle a reduction in pressure of 30 mm. of water, maintained for nearly two hours, whilst the lowest tracing was taken from the subject who showed the greatest reduction in pressure of all, about 50 mm. of water.

It should be noted that in all the cases investigated no significant alteration in blood-pressure or pulse-rate was noticed, whilst subsequent to the sucrose injection no improvement in the mental state or general condition of the subject was noted during the period of investigation.

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Mention should be made of the fact that the subjects under investigation were mostly patients with intracranial tumours especially those in the high-pressure class. Though it might have been valuable to have performed such an inquiry on a series of acute head injuries, such cases were not deemed suitable for investigation.

### Conclusion

These results show that, in the type of cases with which we have been dealing, great reductions in lumbar cerebrospinal fluid pressure are not produced by the intravenous injection of  $100~\rm c.c.$  of a solution of 50% sucrose. The greatest fall produced in this series was only  $50~\rm mm.$  of cerebrospinal fluid and was maintained for less than one hour, at the end of which time the pressure rose again to a point  $40~\rm mm.$  above the pre-injection level.

We are forced to the conclusion, therefore, that the reduction of lumbar cerebrospinal fluid pressure produced by such an injection is very small and in most cases is likely to be of little therapeutic value. We have observed no clinical change in the general condition of the patient under investigation and no significant alteration in respiration rate, pulse-rate or blood-pressure. Many observers have, at one time or another, noted striking changes in the general condition of patients suffering from intracranial tumours following injections of hypertonic sucrose solution, a fact which we have occasionally observed ourselves, but we incline to the view that this clinical alteration is not necessarily due to a lowering of the intracranial pressure as measured by lumbar puncture.

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# Section of the History of Medicine

President-J. F. Halls Dally, M.D.

[February 4, 1942]

# The Folk-Lore of the Acute Exanthemata

By J. D. ROLLESTON, M.D.

[Abridged]

DURING the last two congresses of the International Society of the History of Medicine held at Madrid in 1935 and at Zagreb and Belgrade in 1938, medical folk-lore formed a considerable part of the proceedings, as is shown by the fact that at Madrid 10 papers and at Zagreb 44 were devoted to the subject. The contributors of the papers on folk-lore mostly came from the Balkan countries, but communications of this kind were also made by Belgian, French, German, Italian, Norwegian, Portuguese and South American representatives. The only British contributions at these two congresses dealing with folk-lore were a paper by the late Dr. John Comrie on "The Medical Folk-Lore of Scotland" at the Madrid meeting and one by myself on "Some English Folk-Lore Remedies" at Zagreb. According to Dr. Albert Bazala, general secretary of the Jugoslav Congress (Compte rendu de l'onzième Congrès international d'histoire de la médecine 1938-42), the Proceedings of the Madrid congress were destroyed in the Spanish civil war, and it is more than probable that those of the Zagreb and Belgrade congress shared the same fate.

The present paper which forms a supplement of my Fitzpatrick Lectures on "The History of the Acute Exanthemata" (1935 and 1936) as well as one of a series of previous studies on medical folk-lore (1939-41) deals exclusively with the folk-lore of small-pox, measles, scarlet fever and chicken-pox. There is no folk-lore connected with rubella.

In contrast with other diseases, particularly whooping-cough, pulmonary tuberculosis, skin diseases, especially warts, and eye diseases, the folk-lore of the eruptive fevers is somewhat scanty though sufficiently rich to justify a special communication. The abundance of folk-lore connected with each exanthem bears a direct relation to the antiquity or the importance of the disease, so that the amount of folk-lore of small-pox, measles, scarlet fever and chicken-pox is represented in the order named.

Although the existence of the acute exanthemata in Ancient Greece and Rome was for a long time a hotly disputed subject of controversy, it is now generally agreed that the cruptive fevers cannot be traced further back than the Middle Ages. Nothing, therefore, suggestive of a popular conception of the acute exanthemata can be found in those two great storehouses of classical folk-lore. Pliny's Natural History and the Deipnosophists of Athenaeus. Nor indeed is there anything to indicate the existence of these diseases in Cockayne's work containing the folk-lore of Early England. There do not seem to be any popular causes suggested for their occurrence, such as catching cold, sexual excess, or punishment for an evil life, as in the case of pulmonary tuberculosis, skin diseases and venereal diseases. Except small-pox none of the exanthemata has been attributed to malignant spirits or demons. In comparison with curative measures and in accordance with medical folk-lore generally, prophylaxis is rarely employed in the acute eruptive fevers. There are several examples of the same treatment being applied to this group of diseases generally, such as overheating the patient and flagellation with nettles to bring out the rash, the use of red hangings and bedclothes and coprotherapy. Popular errors connected with the acute exanthemata generally include a tendency to regard them as trivial, a belief responsible for much infant mortality, and the view that they do not occur more than once in a patient's lifetime.

SMALL-POX

Although small-pox did not exist in classical antiquity, it is by far the oldest of the acute exanthemata, having been known from time immemorial in India owing to the temple worship of a deity whose protection and help were invoked on the outbreak of an epidemic. Central Asia was also an ancient focus of the disease as well as China. There has, therefore, been much more time for an abundant growth of folk-lore to have developed in the case of small-pox than in that of the other acute exanthemata. Another explanation of its richness in popular tradition is the fact that small-pox is widely prevalent in the tropics where scarlet fever is almost unknown, and measles is exceptional unless introduced from countries where it is endemic.

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To small-pox alone of the acute exanthemata has a divine origin been assigned, although a few patron saints have been invoked in the case of measles. There are numerous examples on record of outbreaks of small-pox in different parts of the world, such as China, Korea, India, Japan and Malay Archipelago and West Africa, in which the epidemic has been attributed to the agency of a goddess or demon or much more rarely a god, to win whose favour or repel their visitation various methods were employed.

Closely associated with the supposed existence of a divine being causing small-pox is the avoidance of calling the goddess or disease by proper names and substituting more or less euphemistic terms.

Among the Gayos of Sumatra for example the name of small-pox may not be used in the house of a man suffering from it, and the words characteristic of the disease such as "ugly", "red", "stinking", &c., are also forbidden, the title of "prince of the averters of misfortune" being substituted (Frazer. "Golden Bough. Taboo and the Perils of the Soul", 410). A similar prohibition to mention the disease by its name is to be found in Bulgaria according to Stoianoff, who says that when a case occurs in a household a loaf of bread or pastry is made, spread with honey and given to the neighbours with the recommendation to eat it "for the health of the sweet and honeyed disease".

Allusion may be made in this connexion to the euphemistic modern Greek term for small-pox, viz. εὐλογία (kindly inflammation or blessing) which recalls the ancient Greek denomination of Eumenides applied to the Furies.

The idea of transfer of a disease to other persons, animals or inanimate objects which plays so important a part in medical folk-lore is plentifully illustrated in small-pox, examples of the kind being found not only in savage races but also in this country (Frazer, Moncrief).

Prophylaxis.—Lady Mary Wortley Montagu's letter to a friend in 1717 shows that inoculation was a folk-lore practice carried out by old women in Turkey long before it was adopted by the medical profession in England and France. The combination of vaccination with folk-lore methods is illustrated in India where the former is accompanied by worship of the small-pox goddess (Hovorka and Kronfeld), and in Morocco where the vaccinator, if the operation is to be successful, must have killed an enemy in battle (Legey).

In Balkan countries where vaccination is regarded as the work of the devil, other modes of protection are employed by the people such as heavy smoking, keeping grass snakes and swallows' nests and chewing bilberries or garlic (Hovorka and Kronfeld).

Treatment.—Hastening the appearance of the eruption by warm coverings and warming pans, administration of warm tea and brandy, and decoctions of lentils or cynoglossum was a favourite method of treatment. The use of red hangings and bedclothes was used in Japan in the tenth century A.D. or long before John of Gaddesden, who is usually credited with being the first to employ this method. Animal cures consisted in roast mice (Dawson), blood of pigs, pigeons and snails, and coprotherapy in the form of the fæces of cats, cows and sheep (Delaunay, Moodie, Lean). Miscellaneous remedies were as follows: burying the patient up to the neck, a method frequently employed in Gloucestershire, stealing a bun from the shop of a person whose wife when she married did not change her name, and giving it to the patient to eat, a practice current in Cheshire (Wright), and washing the patient at the grave of a murdered man and taking him home by a different way from that by which he came (Spoer).

Patron saints.—Doubtless, owing to its more serious character more patron saints are connected with small-pox than with any of the other acute exanthemata.

According to Du Broc de Segagne the following saints may be invoked—St. Bonose, St. Elie, St. Magin, St. Martin of Tours, St. Matthias, St. Saturnin and St. Rite di Cascia. St. Bonose is invoked because his form of martyrdom consisted in having his flesh torn by iron hooks which produced scars resembling those left by small-pox. According to Bonnerjea St. Martin of Tours may be invoked by those who object to vaccination. St. Nicaise was also invoked with the following words: "In the name of our Lord Jesus Christ, may the Lord protect these persons, and may the work of these virgins ward off the small-pox. St. Nicaise had the small-pox, and he asked the Lord (to preserve) whoever carried his name inscribed 'O, St. Nicaise! thou illustrious bishop and master, pray for me a sinner, and defend me by thy intercession from this disease. Amen'" (Pettigrew, p. 82; Black, p. 93).

#### MEASLES

Popular errors.—Measles has more popular errors connected with it than any other acute exanthemata, viz. (1) Measles is often considered as a trivial disease, whereas its severity and fatality rank very high among the acute diseases of children. (2) It is believed that measles clears out the system and makes a child less liable to contract other diseases. (3) The old "heating regimen" still survives in the popular belief that

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children suffering from measles should not be washed or their body linen changed for the first week of the disease (Rorie).

Transfer.—There are several examples of the belief that measles can be best treated

by transfer to animals or plants,

Animal remedies.—In none of the acute exanthemata is coprotherapy more frequently employed than in measles especially in the early stages of the disease with the object

of bringing out the rash, especially in the form of sheep's dung, which is euphemistically called "nanny-goat tea", "lamb tea" or "nanny pill tea" (Levine).

Plant remedies.—The following plants have been recommended for bringing out the rash: rosemary boiled in water with a tablespoonful of rum added, dried elderberry blossom or marigold leaves with water, decoction of peas either externally or internally, oil of sweet almond sweetened with syrup of maidenhair, and one or two spoonfuls of

the syrup of the flowers of the elder,

Mineral remedies.—The magic and curative properties attributed to stones, especially those with a hole at one end, are exemplified by the Long Stone at Minchenhampton (Glos.) where children are passed through its hole to cure them of measles and other diseases (Hole). In China pearls with honeysuckle are recommended for measles which affects children's eyes (Read). In the seventeenth century bezoar stone was much commended against measles or against small-pox, pestilence, malignant fevers and the like

Patron saints.—A certain number of saints, both in France and Belgium, are invoked for the cure of measles as well as for other diseases, viz. St. Adelard, St. Maginus or St.

Maxime (Du Broc de Segagne) and St. Foy and St. Laurent (Tricot-Royer).

Other folk-lore remedies for measles are washing the patient at the grave of a murdered man and taking him home by a different way from that by which he came; abstention from water for ten days, flagellation with nettles and administration of roast mouse.

#### SCARLET FEVER

Nomenclature.-More than a hundred years before it received its present name in the middle of the seventeenth century, scarlet fever was popularly known as rossania, rossalia,

sofersa, sturola, scurula and rosagia.

Popular errors.—These include the belief, which is not yet entirely extinct even among the medical profession, that the term "scarlatina" indicates a mild form of the disease. Another popular error is that a mild case of scarlet fever is capable of transmitting only a mild attack to another person, whereas it often happens that a mild attack in one individual gives rise to a virulent form in another.

Transfer.—In certain parts of England and Ireland some of the patient's hair is cut off and passed down the throat of an ass who is thereby supposed to receive the infection. A reputed cure for scarlet fever in Cornwall is to drive sheep through the house con-

taining the patient in the belief that they will take the fever with them.

Prophylaxis.—In New Hampshire a camphor bag worn round the neck is regarded as particularly effective in the prevention both of scarlet fever and measles. An amulet containing sulphur has also been used in Scotland in any place where scarlet fever is

Treatment.—The fear of the rash striking inwards which is prevalent in the case of smallpox and measles is also illustrated in scarlet fever, and the patient is therefore made to sweat profusely by various means including the drinking of hard cider, decoctions of rue accompanied by milk and honey and "nanny-goat tea". A popular remedy for scarlet fever in Ireland is the application of the blood of a hare by means of rags which are afterwards burnt. This may be an example of the "doctrine of signatures". The same explanation may be offered for the tongue-shaped pieces of red cloth known as "red tongue" which were tied round the patient's head and were sold in Fleet Street as late as the early part of the nineteenth century as a cure for scarlet fever.

Plant remedies.—In German Switzerland a decoction of Agrimonium Eupatoria was given and in Ruthenia a decoction of rue and garlic. In Belgium mullein flowers mixed with an egg and olive oil and a spoonful of holy water were made up into a poultice and

then thrown over the shoulder without looking back.

## CHICKEN-POX

Nomenclature.—Although this disease is probably as old as small-pox owing to its usually mild character very little folk-lore is attached to it. Like rubella it has a multitude of synonyms in many countries which is out of all proportion to its real significance. In Britain the synonyms at one time were "water-pox", "water-jags", "the crystals", "mirls" or "blibes". In France it was called "crystalline" and "petite vérole volante"

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and in Germany "Schiffspocken" and "Hühnerpocken". I am indebted to His Excellency, M. D. Caclamanos, the former Minister of Greece, for informing me that the modern Greek for chicken-pox is ἀνεμοβλογιὰ, the termination βλογιὰ being a corruption of εὐλογὶα which means "blessing". The term "chicken-pox" was first used in medical literature by Richard Morton, who in his Pyretologia (1694) speaks of a form of small-pox "called in the vernacular the Chick-pox". Fuller also in a paragraph on "Ritteln or Chicken-pox" in his Exanthematologia (1730) writes "I have adventur'd to think that this is that which among our women goeth by the name of Chicken-pox." Under the name of "crystalli", which was obviously chicken-pox Vidus Vidius (Guido Guidi), physician to François I, stated that the vulgar called it ravaglione. It is therefore obvious that folk-lore terms preceded the medical names for this usually trivial exanthem. Another example of folk-lore anticipating scientific medicine is furnished by the fact recently mentioned by W. N. Pickles that the connexion between herpes zoster and chicken-pox has been known among the people in Aysgarth in Yorkshire long before this connexion was demonstrated by Bokay in 1892.

Treatment.—Among the Czechs dry plums are applied to the eruption and St. Barbara is invoked. In Belgium the eruption is powdered with potato meal and starch.

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# Clinical Section

President-Philip Turner, M.S.1

[February 13, 1942]

MEETING HELD AT KING'S COLLEGE HOSPITAL, LONDON

<sup>1</sup> We regret to have to report that Dr. de Bec Turtle died suddenly on December 3, 1941. A tribute to his memory was paid at the Council meeting of the Royal Society of Medicine and at the meeting of the Council of the Clinical Section of which he was President. The Presidency of the Section has been taken over by Mr. Philip Turner, who was elected on December 22, 1941.

# Atrial Septal Defect.—PHILIP ELLMAN, M.D.

E. M. M., aged 26, typist.

First seen May 1940 then completely free from symptoms. She stated that in course of routine examination by Civil Service M.O. (on account of twenty-five days' sick leave in five years) "a murmur was found by the doctor".

Clinical examination.—Somewhat high-coloured facies, no real cyanosis. Heart enlarged to left; apex beat in 5th space 4 in. from mid-line; rhythm regular; rate 84; rough systolic murmur best heard over pulmonary area; pulmonary second sound markedly accentuated; blood-pressure 130/90.

X-ray examination of heart.—Transverse diameter increased, owing to enlargement of right ventricle, with marked aneurysmal dilatation of pulmonary artery (this can be felt) and its branches. On fluoroscopic examination right branch of pulmonary artery shows marked aneurysmal dilatation and excessive pulsation ("hilar dance"); aorta unusually small (fig. 1).



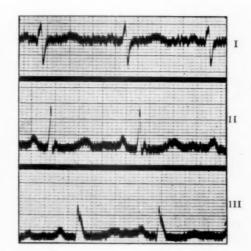


FIG. 1

FIG. 2

FIG. 1.—Antero-posterior film from case of atrial septal defect showing aneurysmal dilatation of the pulmonary artery, enlarged right hilar shadow due to enlargement of the right branch of the pulmonary artery and enlargement of the left border of the heart, due to enlarged right ventricle.

FIG. 2.—Electrocardiogram (see text).

Electrocardiogram shows right axis deviation; rather large bifid P wave in lead II; widening and slurring of QRS in I and III (fig. 2).

The condition is interesting in that, until recently when breathlessness has become rather more marked, the patient has been free from symptoms. She has no clubbing or real cyanosis and has hitherto led a normal life.

## Tuberculous Polyserositis.—Philip Ellman, M.D.

J. T., aged 20, gardener. Present illness began with an acute attack of "influenza" in February 1941, following which he complained of increasing severe breathlessness, a cough with a trace of mucoid sputum, and some swelling of the legs.

Previous history.—No noteworthy illnesses. Family history.—Nothing relevant.

On admission to hospital seven weeks after onset of illness, patient was very ill and cossly orthopnœic. Temperature 97°-102·8° F.; pulse-rate 130; no appreciable chest grossly orthopnœic.

pain; no cyanosis or engorgement of the veins of the neck.

Examination.—Chest: Marked limitation of movement of both sides of chest, especially left, and bulging of præcordium; marked dullness over almost the whole of left chest (except for 1st and 2nd intercostal space, anteriorly and posteriorly), and the whole of left axilla; also dullness over right lower zone, somewhat higher in the axilla; breath sounds absent over areas of dullness.

Heart: Apex beat not then palpable; heart sounds feeble and rhythm regular; rate 130; blood-pressure 130/75; for first three weeks after admission pericardial friction audible

at base of heart; no significant murmurs,

Abdomen: Ascites. Liver palpable. Some cedema of legs. Urinary output at first

diminished but now normal.

X-ray examination (15.4.41).—Lungs: Bilateral pleural effusion especially marked on the left side. Heart: Cardiac silhouette markedly increased. Appearances very suggestive of pericardial effusion (fig. 1).

Electrocardiogram (Dr. East).—Rather low voltage curves in limb leads; negative T

waves in all leads, especially præcordial leads (fig. 3).

All these findings strongly suggested an acute polyserositis. This was confirmed by

paracentesis of the pleuræ and later of the pericardium.

Pathological investigations (Drs. Dacie and Nabarro) (21.4.41).-Pleural fluid: Clear, straw-coloured, some clotting. Polys. 2%, lymphos. 98%. Culture sterile. Ziehl-Neelsen: no T.B. seen. Total protein 4-65 mg.%, serum albumin 2-06, serum globulin 2-59, albumin globulin ratio 0.79. Fluid from pericardium: Clear straw-coloured fluid. Polys. 90%, lymphos. 10%. Culture sterile. Ziehl-Neelsen: no T.B. seen. Total protein 4.7 mg.%, serum albumin 1.75, serum globulin 2.95, albumin globulin ratio 0.59 (Dr. Gray).

Note the difference between the cytology of the pleural and the pericardial fluids. Guinea-pigs inoculated with pleural and pericardial fluids showed tubercles in spleen

Urine: Albumin: a trace. Deposit: an occasional R.B.C. and W.B.C. seen. Direct smear:

no organisms seen. Culture: no growth. Blood: B.S.R. 34 mm. at the end of one hour. R.B.C. 4,260,000; Hb. 78%; W.B.C. 5,600.

Polys. 74%.

Treatment.—The patient has been treated on general lines for his tuberculosis: complete rest, restricted fluids, paracentesis of pleuræ and pericardium. He has also had a course of salyrgan injections. The fluid in the pericardium has been replaced by air on several occasions. He had clinical evidence of a hydro-pneumopericardium with characteristic auscultatory physical signs of a "tinkling splash" over the præcordium. The introduc-

tion of air appears to have retarded the rate of re-accumulation of pericardial exudate.

The final X-ray film (fig. 2) shows a pure pneumopericardium with no fluid and the auscultatory signs have accordingly disappeared. The markedly thickened pericardium is now well seen by radiograph and the heart does not appear to be enlarged. The ascites and cedema of the legs have completely subsided; he still has a small right pleural effusion, the left having resolved. Now completely afebrile; pulse-rate 80-100. He is up all day and has gained weight. General condition good. Blood sedimentation rate and blood-count normal. Repeated examinations of pleural fluid have shown no changes in cytology. Last examination of pericardial fluid (January 1942) showed 88 leucocytes per c.mm., now mainly lymphocytic.

Comment.—Note the comparatively good response to treatment for the time being; the difference until quite recently in the cytology of the pleural and pericardial effusions and the question whether the introduction of a pneumopericardium can have any influ-

ence in the prevention of chronic adhesive pericarditis (Pick's disease).

Diabetic Dwarfism with Hepatomegaly.—W. G. OAKLEY, M.D.

Boy, aged 71/2. Onset of diabetes about March 1939. Treated with diet and 6 units of insulin twice a day. Later admitted to Hutton Residential School (Diabetic Unit)

where the insulin was increased to 10 units twice a day (soluble insulin).

November 1941: found to have characteristic appearance with "moon" face, infantile hands, and enlarged liver. Blood-sugar found to be swinging greatly; treatment changed to 12 units of zinc protamine insulin with 8 units of soluble insulin once a day in the morning before breakfast.

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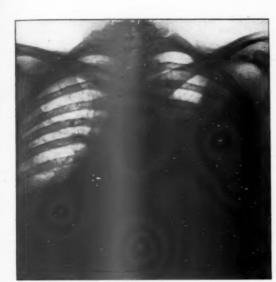
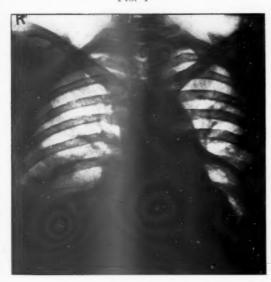


Fig. 1



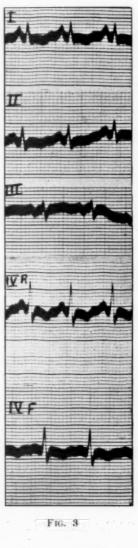


FIG. 2

FIG. 1.—Film of case of polyserositis, bilateral pleural effusions are well illustrated.

FIG. 2.—Pericardial effusion has now been aspirated and replaced by air. A pneumopericardium is well shown and the thick pericardial wall is well demonstrated.

F16. 3.—Negative T waves in all leads—except III which is iso-electric. Præcordial leads definitely negative T waves. Rather low voltage limb leads.

## Hirschsprung's Disease.-R. C. F. CATTERALL, M.Ch. (for Col. H. C. EDWARDS and Dr. PHILIP ELLMAN).

Boy, aged 18. First seen in 1938 with a history of obstinate constipation with occasional attacks of diarrhœa for more than four years. A barium enema showed an enormously enlarged rectum. Spinal anæsthesia induced with 13 c.c. percaine 1/2,000 introduced between L. 3 and L. 4 failed to cause evacuation of the colon although skin anæsthesia was present up to the level of T. 9.

In January 1941 a presacral and lumbar sympathectomy was carried out. Section of the material removed showed the presence of ganglion tissue. The operation was followed by rectal incontinence and a barium enema taken shortly afterwards showed evidence of muscular contraction in the rectal wall. Patient discharged after a month, much improved. June 1941: Readmitted with a return of constipation. This improved with colonic

lavage and regular use of an anal dilator.

February 1942: Readmitted. The clinical condition has relapsed completely.

On examination his general condition is only fair, his tongue coated, and his temperature, pulse and respiration normal. His mental condition remains poor. The rectum is palpable, full of faces, and extending almost up to the costal margin. It would appear that the operation has completely failed to produce any lasting change in the condition.

Postscript (April 1942).—After a thorough course of colonic lavage and remedial gymnastics he has improved sufficiently to warrant his discharge.

Chronic Pancreatitis.—R. S. BRUCE PEARSON, D.M.

Male, aged 20.

First became jaundiced following a cold in February 1941. The jaundice lasted until June, when he was admitted to the West Kent General Hospital. Temperature varied between 97° F. and 99.5° F. He was obviously jaundiced. Stools pale but not typically putty-coloured; bile present in urine, His condition improved. He put on 1/2 st. in weight and the jaundice had practically gone by the time of his discharge early in August.

In September he had a further cold and again became more deeply jaundiced. He was admitted to King's College Hospital on 27.10.41 and again improved with rest and a fatfree diet. His liver was then palpable and hard. He was discharged in November for observation as an out-patient, but following a further cold, again became more deeply jaundiced in December and was readmitted.

He is now considerably jaundiced. He has a hard, palpable liver in the epigastrium. van den Bergh test shows a total bilirubin of 20 units.

Chronic Myeloid Leukæmia.—R. B. NIVEN, M.R.C.P.

Female, now aged 111/2 years.

This case was presented at a Clinical Meeting in March 1941 (Proc. Roy. Soc. Med., 34, 557, Clin. Sect., 9). The symptoms began in the summer of 1940, and in September 1940 she was discovered to have splenomegaly. In March 1941 the spleen was enlarged as far as the symphysis pubis. The total leucocytes at that time were 450,000 per c.mm.

She has had several courses of deep X-ray treatment and has maintained good general

health. The splenic enlargement now reaches only just below the umbilicus. Blood-count, 6.2.42 (Dr. Sheila Newstead): R.B.C. 4,990,000; Hb. 86%; C.I. 0.85; W.B.C. 54,800. Polys. 59.2%, metamyelocytes 24.8%, myelocytes 10.8%, lymphocytes 2.4%, eosinophils 0.8%, basophils 2.0%. No myeloblasts.

The condition is very rare in childhood and the case shows the response to deep X-ray treatment.

## Two Cases of Cerebellar Degeneration.—Wallace Brigden, M.B., M.R.C.P. (for Professor S. NEVIN, M.D.).

(1) Male, aged 63. Complained of unsteadiness in walking which commenced about three years ago, and was associated with slight giddiness. Found great difficulty in balancing correctly, and now walks in a drunken fashion. Readily fatigued on slight exertion. Speech has tended to be slow and slurred. He had also noticed increasing stiffness in the legs during these three years.

On examination.-Mild dysarthria and slight nystagmus to the left. Ataxia of both arms. Some loss of power in legs with slight increase in tone, left being more rigid than right, associated with increase in deep reflexes. Plantar reflexes doubtfully extensor.

These symptoms and signs are thought to be consistent with a late cerebellar degen-

(2) Male, aged 65. Complained of inability to walk properly, associated with pains in the left leg. These symptoms had been coming on for five years. Difficulty in walking shown by a general unsteadiness, weakness of the left leg and a tendency to walk over to the right.

On examination.—Shuffling gait; patient walks on a wide base with tendency to deviate to the right. No Rombergism; slight ptosis and slight lateral nystagmus. Both arms show considerable ataxia, brisk deep reflexes and no sensory changes. Abdominal reflexes absent. Legs: Considerable inco-ordination; plantar reflexes indefinite, probably extensor. Mild hyperpiesis.

It is considered that he has a late diffuse cerebellar degeneration. There has been some improvement in symptoms since treatment with vitamin B complex.

### Thoracic Swelling: Tuberculous Abscess.—A. GILPIN, M.D.

Female, aged 30. Complained of pain in the chest during the past year, with swelling

of the right side of the chest for one month.

On examination.—General condition good. No abnormality in the cardiovascular system. A diffuse painless swelling, about the size of a plum, was situated over the 10th and 11th ribs in the posterior axillary line. There was impaired movement and air-entry over the lower part of the right chest. Aspiration of the swelling gave no result.

Investigations.--B.S.R. 52 mm. in the first hour. W.B.C. 9,400 per c.mm. of chest showed an opacity in the lower lateral part of the right lung, suggesting an encysted pleural effusion. X-ray of ribs and vertebræ showed no bony disease.

This swelling has since been operated upon, and proved to be a tuberculous abscess,

although the source of the infection still remains obscure.

### [March 13, 1942]

## MEETING HELD AT UNIVERSITY COLLEGE HOSPITAL, LONDON

Cystic Disease of the Lung.—K. J. Mann, M.D. (for Kenneth Harris, M.D.).

Mr. L., aged 65. History.—Perfectly well up to 1938. No cough. No sputum. 1938: Catarrhal jaundice. Chest X-rayed as a routine—bullæ found at right apex and ? left apex. Discharged from hospital well, no cough.

1940: Ill with influenza, followed week later by cough and sticky sputum. Admitted

as a case of pneumonia. Kept in hospital for eight weeks. Left well, no cough,

October 1941: Cough returned, sputum not purulent. Attended out-patients' department as bronchial for three months.

January 1942: High temperature; rhonchi both sides of the chest; pneumonia. Admitted

Radiogram showed bullæ right apex with slight pneumonitis round it. Temperature fell after sulphapyridine. A few days later temperature rose again. Cough and sputum. Dullness right apex. Bronchial breathing. 30.1.42: Radiogram showed diffuse area of consolidation of right upper half with fluid levels in ? cysts. Sulphanilamide and sulphapyridine tried with no result.

Condition at present stationary with high temperature, cough and sputum.

Sputum showed no tubercle bacilli and no actinomycosis on direct examination or anaerobic culture. Bronchoscopy showed mucoid discharge from right upper bronchus but no evidence of growth.

# Four Cases Showing Results of X-ray Therapy.—E. L. G. HILTON, M.B., D.M.R.E.

(1) Spondylitis.

A. H., male, aged 22. 3.2.41: History of pain and increasing stiffness in back of three

years' duration. Stiffness and pain in hips for one year. Unable to work.

On examination.—Pale, thin man. Can only walk slowly and with difficulty with aid of two sticks. Great limitation of movement in spine from 6th dorsal vertebra downwards, Limitation of flexion of hip 130°

Radiogram: Wedging of 6th dorsal vertebra. Spondylitic changes especially in lumbar region with new bone formation.

3.2.41: Deep X-ray treatment to whole spine commenced.

18.3.41: End of treatment. No pain. Movement slightly less limited. Walking improved. 9.9.41 to 22.9.41: Deep X-ray treatment to both hip-joints, for pain and difficulty in walking. Considerable improvement at end of treatment.

4.3.42: General condition.-Looking much better. Still limitation of movement in spine and hips, but no pain. Can now walk moderately well without sticks. Has put on I st. in weight and is at work.

(2) Lymphadenoma.

O. G., female, aged 31. 28.3.41: Six months' history of swelling in groins and neck, and pain in lower part of back. Biopsy report: Lymphadenoma. Radiogram: Mass in left hilum and mediastinum. ? deposits both sides of sacrum.

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General condition.—Patient looked ill, with a swinging temperature; high irregular pulse, profuse sweating. Enlarged glands in both cervical chains, groins and axillæ. Spleen just palpable.

28.3.41 to 16.5.41: Course of deep X-ray treatment to all glands and mediastinal mass. 16.5.41: General condition much improved. All glands smaller. Temperature remains

normal. No sweating. Discharged fit. 28.10.41: Developed typical erythema nodosum.

28.1.42: Swelling and induration of outer side and middle of left leg. ? lymphadenomatous deposit. This subsided with a course of deep X-ray therapy.

(3) Pharyngeal Carcinoma.

G. L., male, aged 58. History (10.12.40).—Difficulty in swallowing and irritation at

back of throat for eight weeks.

On examination.—General condition good. Local condition: Swelling of posterior pharyngeal wall in mid-line, occluding view of larynx. Hard mobile gland in right cervical chain,  $3 \times 2$  cm.

Biopsy: Carcinoma with no differentiation into cell nests. Several mitoses present.

Radiogram showed soft tissue swelling of posterior pharyngeal wall.

11.12.40 to 21.1.41: Course of deep X-ray therapy. Swelling much reduced and gland much smaller at end of treatment.

16.1.42: General condition good. Symptom-free. Local condition: Slight glazing of mucous membrane. No signs of recurrence. Gland not palpable.

Radiogram: No sign of the soft tissue swelling.

(4) Carcinoma of Left Breast with Secondary Gland in Axilla. Inoperable.

E. P., female, aged 80. History (5.7.40).—Lump in left breast for four months.

On examination.—Lump 4.5 cm. in diameter in nipple region. Nipple retracted.

Attached to deep structures. Large, hard, fixed gland in left axilla.

10.7.40 to 13.9.40: Course of deep X-ray therapy.

13.9.40: Lump in breast and axillary gland much smaller.

12.2.42: General condition good. Breast: No tumour palpable. Glands: None palpable. No distant metastases.

Pancreatic Deficiency.—J. F. Stokes, M.R.C.P. (for Kenneth Harris, M.D.).

L. W., male, munition worker, aged 39.

Complained of diarrhoea for six months and loss of 4 st. in weight during the same period; slight tingling of hands and feet for a few weeks. Stools have been pale and

Examination.—Generalized wasting; knee and ankle jerks not obtained. Urine loaded with sugar. Blood-sugar curve diabetic. Stools contain 43% fat, of which 95% is unsplit; no muscle fibres seen in stool; no occult blood. Wassermann reaction negative. Blood-count: R.B.C. 4,000,000; Hb. 94%; C.I. 1·1; W.B.C. 4,400 (polys. 39%, lymphos.

57%, monos. 2%, basos. 2%).

Treatment.-3,000 calorie diet; diabetes controlled on insulin 35-15-5. Pancreatin tabs. ii t.d.s. Stools after treatment contained 20% fat, of which 80% was split; excess of undigested muscle fibre present. Insulin requirement now rising; weight steady.

Malignant Tumour Pressing on Brachial Plexus Complicating Paget's Disease.—Hugh BURT, M.R.C.P.

S. C., male, aged 54.

History.—Pain down inner border left arm and forearm and in 4th and 5th fingers of left hand with increasing weakness of limb nine weeks. Tingling left side of face three weeks, right-sided deafness eight months. Loss of 1 stone in weight six months.

On examination.—Visible swelling left posterior triangle of neck, hard in consistency and firmly attached to underlying structures. Left arm: wasting of all muscles especially small muscles of hand. Anæsthesia to pin-prick and light touch 4th and 5th fingers and ulnar aspect arm and forearm.

Slight left ptosis, weakness of left masseter, right nerve deafness.

Radiograms: High first rib of cervical type on left side with small area of erosion anterior to angle. Opacity in upper part of chest, corresponding to lump. Pelvis: advanced Paget's disease; skull shows Paget's disease with narrowing of left foramen ovale. Exploration of neck (Professor Pilcher): Tumour fixed posteriorly to prevertebral fascia infiltrating roots C.8 and D.1.

Biopsy: Spindle cells with numerous mitotic figures, some foam cells and giant cells. Comment.—Paget's disease with cranial nerve involvement; malignant tumour pressing on brachial plexus. ? sarcoma secondary to Paget's disease. n

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# Section of Anæsthetics

President-A. D. MARSTON, D.A.

[May 1, 1942]

#### Convulsions

By Flying Officer E. A. PASK, M.B., B.Ch., D.A.

ANÆSTHETIC convulsions first began to concern anæsthetists in the year 1926 and in 1927 a number of cases of convulsions occurring in patients under di-ethyl ether anæsthesia were reported to a meeting of this Section [Proc. Roy. Soc. Med., 20, 185 (Sect. Anæsth., 1)].

It has become impossible to regard di-ethyl ether as their specific cause, since convulsions have been reported during anæsthesia induced by many other agents. The convulsions have at different times been attributed to the following: Impurities in the anæsthetic agent; impurities in the oxygen administered; impurities derived from the anæsthetic apparatus; the effect of administering vapours which were too hot; the stimulation of vapours which were too cold; excessive concentrations of carbon-dioxide which were too small; excessive amounts of oxygen; too little oxygen, anoxia; excessive morphinization; too little morphine premedication; excessive atropin premedication; respiratory obstruction; surgical stimulation; overheating of the patient; diminished level of calcium in the blood; cerebral congestion; epilepsy; disturbance of renal function; a specific convulsant organism in the nasopharynx.

Despite this variety of causes, the impression has been widespread that the convulsions constitute a homogeneous group, with a specific nature and for which a specific cause should be discoverable.

Are we, in fact, dealing with "anæsthetic convulsions" or with convulsions occurring while the patient is anæsthetized?

In 1926 anæsthetists seemed to have been convinced that they had to deal with a completely new complication of anæsthesia. So strong was this opinion that at first some change in the nature of the ether used, due to an alteration in the method of manufacture, was suspected, but none was discovered.

On reflection, however, this proposition that in 1926 an entirely new complication of anæsthesia arose and has continued ever since, even though the methods of administration prior to that date were substantially similar to many which have been used since, lacks supporting evidence.

At the meeting of this Section in 1927 [Proc. Roy. Soc. Med., 21, 1705 (Sect. Anæsth., 39)], when the first cases described as "Ether Convulsions" were discussed, Dr. Kirby Thomas recalled five cases of convulsions under ether anæsthesia which had occurred prior to 1926, though his comment does not seem to have received great attention. In 1937, in the British Medical Journal (ii), 996, Mark Taylor recounts a case of convulsions under ether anæsthesia which occurred in the early eighteen fifties. F. W. G. Smith, in the Irish Journal of Medical Science, 1936, p. 582, states that: "Osler and Macrae, writing at a time when ether convulsions were not recognized, in a description of thymic death say that, in some cases, convulsive attacks occur causing death during operation or several hours after the patient has come round from the anæsthetic."

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In looking through the Hyderabad and Lancet Commission report on chloroform and ether calamities the first thing one notices in this record of disaster is the frequency with which the word "convulsion" occurs.

Of the many cases of convulsions and convulsive movements recorded, I will quote two.

Case 55.—Patient, male, aged 30. Anæsthetic, chloroform. "Raised hands and trembled, kept spitting at the lint, appeared about to vomit. Suddenly he was convulsed as if in an epileptic fit . . . convulsions lasted only a few seconds, he began to breathe with difficulty . . . pulse almost imperceptible and irregular, relapsed and could not be recovered."

The early part of the description suggests that the patient was lightly anæsthetized, yet the cause of death is finally ascribed to "deep coma". If this should not now be described as a case of anæsthetic convulsions, what should it be called?

Case 18.—Female, aged 40. Anæsthetic, ether. "Removal of urethral polyp and two sebaceous cysts, Anæsthesia incomplete, ether was not pushed further because stage of excitement did not come on. When the operation was completed coldness increased with clammy sweats, convulsions, foaming at the mouth. Attack passed away but returned, more severe. After fourth attack the patient died from eclampsia attributed to etherization."

Again the patient is said to be incompletely anæsthetized but it is clear from the account that the anæsthetist was rather confused about the situation. Though the stage of excitement, on which he seems rather unwisely to have relied, did not appear the patient seems to have been deep enough for the operation to be performed. It is not easy to recognize a condition under light ether anæsthesia in which the patient would become convulsed, collapsed and die, after the operation is completed.

Neither can we state that this is unquestionably a case of anæsthetic convulsions, but that is not our problem. If the proposition we have been discussing is to be supported, we must be able to say that such cases as these certainly are *not* cases of anæsthetic convulsions and this we cannot do.

We may, therefore, conclude that the evidence for the assumption that anæsthetic convulsions did not occur prior to 1926, is wholly inadequate, and that the initial case for considering that anæsthetic convulsions constitute a specific entity must fail.

Are we in fact dealing with "anæsthetic convulsions" or are we rather dealing with convulsions arising as a symptom in an unsatisfactory anæsthetic situation?

Many case-histories and commentaries have appeared in the literature in which a particular feature of the symptomatology or pathology has been selected, and a theory of the nature and causation of anæsthetic convulsions built up around it. It is not always realized that though the theory raised may to some extent account for the particular incident described, there is no warrant for assuming its relevance to anæsthetic convulsions in general.

Even more dangerous perhaps, is the practice of drawing deductions from the effectiveness or otherwise of a particular form of treatment. As causation of anæsthetic convulsions is almost certainly complex in all cases we may anticipate their inhibition by different lines of treatment. It is impossible to deduce anything as to causation from the effectiveness of the barbiturates in checking these convulsions. It seems very likely in this case that the agent stops anæsthetic convulsions for much the same reason, whatever it may be, that it stops a variety of other convulsions. We would, perhaps, do well to inquire whether the same observation might not be made concerning other "curative" measures which have on occasion been quoted in support of a particular theory of causation.

At least two published papers, however, have taken a wide view of the situation. In 1937, Brennan in a paper in the British Medical Journal showed that many differing factors may combine together to produce a condition of "overheating" in an anæsthetized patient. When in this condition the patient may be convulsed in response to a neurogenic stimulus.

F. W. G. Smith (1936) reviewed many of the suggested causes of these convulsions and produced evidence to refute a number of them. Evidence was given that this disorder did exist before 1926, and reasons were suggested which might account for an increase in frequency since that date. He too concluded that there is a resemblance between the convulsions of heat-stroke and anæsthetic convulsions.

We know that over-heating of an anæsthetized patient may determine a convulsive state and further that it is particularly easy to cause such over-heating in an anæsthetized patient. In view of our knowledge of the general effects of over-heating, it would, indeed,

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be surprising if these two statements were not true, but it is quite another matter to assign a "Heat-stroke" basis to all cases of anæsthetic convulsions.

It has been suggested that the clinical appearance of the convulsions is in some way pathognomonic of the condition and that because these convulsions resemble, clinically, convulsions arising in different circumstances, then a similarity of causation may be assumed. I remember, for example, being told when I was a student, that a "true" ether convulsion could always be recognized because it commenced with twitchings around the eyes and that this sign was quite pathognomonic. It is true that this sign may enable the "late ether convulsion" to be differentiated from what we may perhaps, describe as "induction hyperventilation tetany", but I suggest that neither this nor any other element in the appearance of the convulsions is specific to the condition. Such factors do not permit us to draw either comparisons or differentiations in respect of convulsions occurring in other circumstances.

Here is an account of two cases of convulsions.

PARFITT (1937): "The twitchings which have been noted as occasionally occurring around the mouth and eyes generally begin to increase and spread during this period. Small myoclonic movements are seen in the muscles of the hands and then in the arms, lower limbs, and body. . . These myocionic movements increase in force and numbers until combinations of contractions produce jerking of whole limbs and finally violent jactitations may throw the patient out of bed."

BEHNKE (1934): "During the 44th minute, however, a temporary twitching of the left eyebrow was observed. The subject uttered a short cry and developed a convulsion characterized in the beginning by violent clonic movements and then by tonic contractions of the muscles of head, trunk and extremities. Cyanosis did not appear, sphinter control was maintained. With the subsidence of the convulsions the subject was in a stuporous condition for about thirteen minutes. During this period the face turned ashen grey colour, beads of perspiration appeared on the forehead and the breathing became stertorous."

With the elimination of one or two minor "clues" either of these descriptions would pass very fairly for a description of a case of anæsthetic convulsions. The first description applies, however, to a case of convulsion occurring during insulin shock therapy and the second, and this may account for the absence of cyanosis, to convulsions in a subject who was breathing pure oxygen under the increased pressure of three atmospheres.

Convulsions clinically similar to these and to anæsthetic convulsions have been described in subjects submitted to anoxia, to an excessive alveolar concentration of carbondioxide, in heat-stroke, in hyperpyrexia and in other conditions. Convulsions are, after all, recognized in general medicine as quite non-specific signs.

#### CONCLUSIONS

- (1) That we may not assume that convulsions occurring under anæsthesia are specific in nature nor that they necessarily have a single specific causation.
- (2) That whether a patient is anæsthetized or not, in the presence of certain predisposing conditions, a sufficiently strong stimulus may evoke a convulsion. The strength of the stimulus required will depend on the weight of the predisposing conditions. The nature of this final stimulus will not necessarily be the same in all cases, even though the clinical appearance of the resulting convulsions may be similar. We must also accept the possibility that several different stimuli may act together to produce a stimulus level adequate to excite a convulsion.

We may divide the factors surrounding the development of anæsthetic convulsions into three groups: Predisposing Conditions, Inhibiting Factors, and Immediate Stimuli.

Such a grouping of a certain number of possible factors is shown below. This classification is incomplete and some of the factors are incorrectly placed, and its only basis is that of convenience.

Many of the predisposing conditions listed here are recognized as predisposing to the development of convulsions in conscious patients.

I shall illustrate the idea behind this table by two hypothetical examples.

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I think we might assume that a patient who is young, has a high temperature, and whose ability to lose heat by sweating has been impaired by a large dose of atropin, might become convulsed if subjected, for example, to a high alveolar tension of carbon-dioxide. Had a barbiturate been given, it is possible that in similar circumstances a convulsion would not appear, since barbiturates seem in general to act as inhibiting factors to convulsions.

For our second hypothetical case we might imagine a more elderly patient in whom a severe infection has been present for a long time. Perhaps deep anæsthesia interferes with the function of the central temperature regulating mechanism, while the final stimulus may be represented by a persistent degree of anoxia, due maybe to the anæsthetic, upon which is superimposed at one point a profound surgical stimulus.

When faced with a case of convulsions under anæsthesia have we perhaps been a little too anxious to inquire: "What is the cause of Anæsthetic Convulsions?" May it not be more profitable to inquire rather: "What combination of factors has led to this disorder, which manifests itself by convulsions, in this particular patient?"

The result of such inquiries may be that eventually a single theory of nature and causation will suffice.

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Dr. F. F. Waddy then read an account of Two Cases of Convulsions. This is to be published in the British Journal of Anæsthesia.

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# Section of Psychiatry

President—Lieutenant-Colonel A. A. W. Petrie, R.A.M.C.

[January 20, 1942]

# The Role of Mild Cerebral Commotion in War Neurosis

By W. LINDESAY NEUSTATTER, M.D.

In the last war commotional disturbance was at first held responsible for "shell-shock" until its emotional determination became apparent. Although this is generally so, nevertheless under the comprehensive heading of war neurosis a number of symptoms occur, where one is not always satisfied of their psychogenic origin.

Moreover the part played by commotional disturbance in the production of psychiatric disorders is of particular interest in this war, as in the case of civilians, injury allowances are only payable for physical injury, and not for "symptoms induced merely by apprehensions and fears occasioned by enemy activity". And though there is nothing in the Royal Charter to prevent an ex-Service man receiving payments for a purely emotionally determined condition, his claim is far harder to establish if this is the case.

The importance, therefore, of making sure that none of the patient's symptoms is attributable to physical injury is obvious, and the difficult question frequently arises of the assessment of symptoms which may be psychogenic or physiogenic. (1) In particular there are a number of subjective symptoms accepted as due to trauma, but which closely resemble those of psychoneurosis, especially neurasthenia. These are headache, dizziness or giddiness in relation to posture, impaired memory, concentration and judgment, and undue fatigability, a syndrome commonly known as "post-traumatic neurasthenia" (Oppenheim, 1911), a term rightly criticized by Schilder (1940) as suggesting psychogenesis. Mapother (1937) has called it "post-traumatic psychasthenia", but Symonds' "minor contusion syndrome" is perhaps the best term (Symonds, 1940).

(2) Is one justified in assuming that symptoms of anxiety are always psychogenic? Cases have been reported of stable individuals with complete amnesia for a head injury, and with no compensation involved, who have developed anxiety symptoms which are generally regarded as caused physiologically. May not some anxiety reactions, which occur subsequent to some degree of "cerebral trauma", in otherwise completely stable individuals be at least partly physiologically determined? Even if they are caused by fear, may not physiological factors be preventing the regression of fear, which is normal in stable individuals?

(3) How far is it justifiable to argue that when a previously stable individual develops a psychiatric disorder subsequent to enemy action, nevertheless constitutional factors are solely responsible? (A line of reasoning adopted by some invaliding boards.)

(4) How far are the patients symptoms motivated, i.e. hysterical?(5) What degree of disability do psychoneurotic symptoms produce?

Procedure.—Three groups of 30 cases showing psychiatric disorders were investigated

by questionnaire and, where possible, reference to documents, as follows:

(1) Soldiers developing psychiatric disorders who had not been in action. (2) Service men and civilians subjected to enemy action, but not subjected to blast. (3) Cases subject to blast, but where there was no evidence of gross head injury. They were chosen as far as possible to conform with what Symonds (1940) calls slight general cerebral contusion, i.e. where the unconsciousness does not exceed five minutes, and there is no gross evidence of injury.

The cases in group 1 exhibited symptoms for a variety of periods from months to years, depending on when their M.O.s referred them on. In groups 2 and 3, from 6 to 15 months had elapsed since the time of the trauma. (Acute cases were not included in this series.) Cases of definite head injury, e.g. fractured skull, or where there was evidence

of prolonged unconsciousness, were excluded, as irrelevant to this inquiry.

\*Results.—Table I shows the frequency of occurrence of symptoms generally recognized as psychoneurotic, i.e. expressions of anxiety. Insomnia and irritability might well go

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#### TABLE I.-ANXIETY SYMPTOMS.

		Age (average)	Depression	Anxiety	Hysterical symptoms*	Obsessional symptoms
Group	1	 36	28	24	4	4
Group	2	 32	24	26	9	4
Group	3	 35	18	24	10	0

 $\star$  This means that some hysterical symptoms were present, e.g. a poorly performed nose-finger test, but the symptoms were not the main feature of the case.

For all Tables: Group 1.—Controls of 30 Soldiers not exposed to enemy action.

Group 2.—30 Servicemen and Civilians exposed to enemy action, but not to blast.

Group 3.—30 Servicemen subjected to blast.

in this table, but as the figures for these were almost the same throughout the three groups, it is of no consequence. In groups of 30 none of the differences appear significant but the small number of obsessional features in any group is noticeable.

Table II shows the occurrence of symptoms of the minor contusion syndrome. These figures are almost constant throughout. It is to be noted that headache and giddy attacks

TABLE II.—SYMPTOMS OF "MINOR CONTUSION SYNDROME".

Group 1	Impaired memory*	Impaired concentra- tion*	Headaches	Headaches continuous	Headaches in relative posture	Attacks of giddiness	Vomiting	Irrita- bility 20	Insomnia 20
Group i	A 40	20	10	0		0	-	200	20
Group 2	4	10	20	0	3	4	0	22	18
Group 3	13	13	15	'4	5	6	4	16	17

\* This refers to the patient's statement, and not to my findings.

in relation to posture, and vomiting, were infrequent even in group 3, and occurred also in group 1. The more ambiguous symptoms, e.g. insomnia, irritability, lack of concentration and poor memory are frequent and common to all groups. "Poor memory and lack of concentration" refers to the patient's statements, and not to my observations, but, as Symonds (1937) points out, even in organic conditions it may be necessary to rely on the history with regard to these. Impaired memory features little in group 2.

Table III. Improvement and working capacity.—In all groups it will be seen that about one-third of the cases improved. In this small series nothing emerged regarding the

TABLE III.—COURSE, IMPROVEMENT AND

		1	PER	PE.	TUA	TI	NG	FAC	TOR	S.						[A]	BL	E ]	[V	-PA	SI	PE	RS	ON	AL	TY.	
Group	Treatment received	Not improved	Slightly improved	Moderately improved	Greatly improved	Total	Delayed symptoms	with	Woderate Work	king	Financial worries	Domestic worries	House destroyed	Business destroyed	Excitable	Introverted	Cyclothymic	Anxions	Overconscientious (obsessional)	Depressed	Imaginative	Great fear of enemy action	Neurosis treated	Psychosis treated	Total symptoms of instability	No. of cases having no past symptoms of instability	
1	 _		_	N	ot c	omp	arab	le -		_	6	0	0	2	8	16	18	14	6	8	8	8	10	2	98	-	
2	 10	18	8	4	0	12	7	12	10	8	6	2	1	2	4	8	5	10	3	3	4	5	2	0	44	7	
3	 18	18	4	4	4	12	5	11	12	7	5	1	1	3	7	1	3	8	5	6	4	1	1	0	36	9	

relationship of improvement to treatment. The two are not necessarily related. Improvement and working capacity were not assessed in group 1, as most of the men were still in the Services and not comparable to groups 2 and 3. In regard to impaired working capacity, in my experience one must not underestimate true disability in the patient who is genuinely trying to overcome it, and working under a handicap. It does not seem right that he should receive less for his disability than the patient who gives in to it. Domestic and financial worries occurred relatively few times. Had more bombed civilians been included this would probably have been higher (vide infra).

Table IV. Past personality was assessed by questioning, past records, and my impression of the patient. Where all three entries were negative, it seemed reasonable to assume that the patient's past personality was normal. (I must confess that in regard to obvious hysterics, who insisted that they "Had never known what it was to be nervous", or made similar assertions, I prejudged the issue and rejected their statements as too problematical to warrant inclusion.) The term "anxiety state" has been used in the usual sense. However, I should agree with Brend (1941) that many of them are really "conditioned fear" states, i.e. they are responses to a reality situation, e.g. bombs.

Using the above criteria, 7 of group 2, and 9 of group 3, showed no signs of an unstable past personality. (*Ipso facto* Group 1 was excluded.) Of these 16 15 developed anxiety

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ble etv states; one strongly coloured by depression, and one schizophrenia. The latter was especially interesting, as there seemed to be definite evidence that his condition originated on the crossing from Dunkirk, but there was no definite evidence of head injury. Reports confirmed by his mother showed that before this he was perfectly normal.

Headaches.—Brend (1941) points out that headache is the presenting feature in organic cases, an observation with which I would agree, although noticeably in my series it occurred in about half the cases in all groups. As the patients were asked if they had headaches their number not unnaturally looms large, but they were not necessarily severe or complained of spontaneously.

Hysteria.—There is a not uncommon assumption that pension or Workmen's Compensation cases are generally purely gold-diggers. It is worth while, therefore, drawing attention to (a) the small number of hysterics in this series of cases, which appears to be in conformity with general findings in this war to date, and (b) to the fact that their reactions are often, not a desire to make something out of the war, per se, but the result of a very real anxiety and worry. For example a small shopkeeper had his shop and business destroyed, and a seamstress had part of her house blown away and her clients evacuated from the district, leaving her workless; both had an anxiety hysteria the motivation of which was easy to understand.

# DISCUSSION

Before considering the role trauma plays, it is useful to see how far constitutional factors are a sufficient explanation in themselves.

Constitution obviously plays a part in any disorder, but the degree to which it is brought in is usually directly proportional to the prevailing ignorance of the pathology of the condition; hence its frequent appearance in psychiatry. But to invoke it as an explanation of a war neurosis, without any evidence of past personality disorder, is to argue post hoc ergo propter hoc. Therefore it is significant to note that out of 60 cases, selecting only those which strictly conformed to the standards laid down, as many as 16, or approximately a quarter of those whose disorders developed subsequent to enemy action, appeared to have had previously normal and stable personalities. In such cases it is quite unjustifiable to dismiss the precipitating factors as of no importance compared to constitution, yet this is often done.2

Commotional factors.—As the anxiety symptoms in Table I are so evenly distributed throughout the groups, it is not possible to argue from this inquiry that cerebral contusion plays a causative part in producing them. The fact that the symptoms of "minor contusion" feature equally in all groups in Table II confirms their ambiguity as diagnostic criteria in themselves. On the other hand, it does not exclude the fact that some of them may be organically determined, and that in a given case a mixture of psycho- and physiogenic symptoms may be present. A clinical as opposed to a numerical analysis would appear to substantiate this, as exemplified by the following case.

Mrs. S., a widowed chiropodist of 67, was blown through a doorway by blast. She had no memory of the explosion, but remembered picking herself up, and feeling very dazed. The next day she had a headache, and fet extremely shakey. These symptoms persisted for seven months, and she was unable to work because her hand was too unsteady. On examination she was very anxious and emotional. This was quite unlike her former self, she declared. She had unequal pupils, which reacted normally, and commotio retinae. Her right ankle-jerk was diminished and there was a coarse termor of the right hand. W.R., C.S.F., and X-ray of the skull were normal. After two months in hospital only the commotio retinae and absent ankle-jerks persisted. Her headaches had almost disappeared. She was far less emotional, but her tremor, which was obviously hysterical, persisted. It was probably a continuation of a tremor originally due to fright. Its motivation was clear. Her lesiness, actual and potential, had been entirely destroyed by bombing, and her confidence in her ability in wielding a chiropodist's knife had gone, and at 67, with no capital, she had nothing but public assistance to look forward to.

The case illustrates the coexistence of three parallel disorders, viz.; (1) Anxiety symptoms presumably due to fright. (2) A hysterical perpetuation of these arising out of her precarious financial position. (3) Headache, vomiting, emotional lability, and commotio retine, the outcome of physical trauma. The signs of the latter had been masked by the patient's own pre-occupation with psychogenic symptoms.

#### The Role of Commotion in the Possible Production of Anxiety Symptoms

The clinical study of certain cases in the series still leaves a doubt as to whether commotion can so readily be completely excluded, as nowadays there is a tendency to The occurrence of similar symptoms irrespective of cerebral trauma suggests fear as the common factor causing the condition, but may not commotional disturbance interfere with their subsidence? Following head injury or cerebral arterial disease patients may be emotionally labile, presumably the inhibiting functions of the cortex

<sup>11</sup> have differentiated between the patient all of whose symptoms were hysterical, and those cases where, for example, there is an exaggeration of a solitary symptom at examination, e.g. a tremor.

2 Curran and Mallinson (1940) have shown that unpredictable cases of breakdown often have a positive family bistory, but unfortunately 1 had no reliable records of these.

having been interfered with. Might not some similar interference with an inhibiting mechanism prevent the normal resolution of anxiety symptoms?

The following are examples of case-histories where such queries appear to arise:

A stolid railway-guard of 63, with forty years' excellent service, who had never been nervous in any way, was blown from his guard's van. He lay dazed on the permanent way, picked himself up to fight a fire in his train, was blasted into this, but luckily escaped quickly enough to avoid burns, ran to a signal box only to have it blown all around him—again without apparent physical injury. Six months after he still had recurrent nightmares of his experiences and was intensely nervous of raids. He was then discovered to have commotio retine, showing that he had suffered physical as well as psychic trauma.

The other cases were merchant sailors of over 60. Two were at Zeebrugge without nervous sequelæ in the last war. The third said this was his fourth war. None had previously known what it meant to be nervous. All three had become intensely nervous after their ships were bombed for the first time, in this war, and remained so.

In such cases, how far is cerebral arteriosclerosis a factor? None of the cases had objective signs of this, which of course does not exclude it. In none of these cases can I produce evidence that physiological changes caused the symptoms, nevertheless I wonder whether the *persistence* of these symptoms can be attributed entirely to psychogenesis, even though they were caused by this? Then the immediate question arises: Is it right that claims for an injury allowance should depend on the examiner's views on pathology? Would it not be more satisfactory to inquire not whether the symptoms are merely caused by fear and apprehension, but to decide instead whether they are being perpetuated by psychological causes? This would still leave the examiner latitude in deciding whether enemy activity had produced or materially aggravated a condition, but would get away from the anomaly of having to reject claims wherever there was no apparent physiological injury, and yet severe psychic trauma existed. (For example: A woman patient of mine was trapped for seventy-two hours beneath a bed. She was physically unhurt but she could hear the screams of her four children whom she could not reach, three of whom died before they could be rescued.)

The undesirability of paying pensions for functional disorders is axiomatic, and provision has been made for free in-patient treatment for these cases instead, but unless they are discharged as completely fit there is still the problem that during the continuation of the war there will be many vulnerable areas in which they are unable to work. They are therefore placed at a disadvantage compared with the average man in the labour market. As these facts are accepted as grounds for paying an allowance, I contend there is a case for granting a partial injury allowance for these with a genuine "conditioned fear " state-an allowance which would naturally cease with the termination of hostilities.

#### SUMMARY AND CONCLUSIONS

Three groups of 30 cases are compared, viz. (1) Soldiers not exposed to enemy action, (2) soldiers and civilians exposed to immediate enemy action, but who were unscathed, (3) cases who had suffered slight cerebral commotion but no physical injury.

The evidence does not suggest a physiogenic cause for the psychoneurosis, but it is argued that physiological causes may prevent the subsidence of anxiety symptoms. Organic post-concussive symptoms may co-exist with, and be masked by, psycho-

genic ones where the latter are prominent.

In view of the frequent difficulty of determining the psycho- or physiogenesis of symptoms the desirability of assessing purely on the degree of disability irrespective of the cause is contended.

Some war neurosis may be the cause of genuine partial physical disablement and

a case for injury allowances for the duration of the war is stated.

Where no positive evidence of previous personality disorder exists, it is not justifiable to dismiss the precipitating factors in favour of constitutional ones.

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# Section of Therapeutics and Pharmacology

President—R. D. LAWRENCE, M.D.

[April 21, 1942]

#### DISCUSSION ON TRINITROTOLUENE POISONING

Dr. J. C. Bridge: The earliest cases of toxic jaundice before the last war were attributed to dinitrobenzol. Then jaundice, associated with liver damage, was noted in 1914-16 (some 70 cases) among those employed in doping aeroplane parts with a solution containing tetrachlorethane [Willcox, W. H., Spilsbury, B. H., and Legge, T. M. (1915) Trans. Med. Soc. Lond., 38, 129]. Then came similar cases of liver damage from T.N.T., which continued until the end of the war in 1918. A few cases occurred after the cessation of hostilities, when chlorinated naphthalene appeared as another cause of liver damage, and produced the same pathological changes as T.N.T. Why the chlorination of the non-toxic naphthalene, not its nitration, should produce the same pathological effects as the nitration of toluol is an unsolved problem.

It is impossible to give the incidence of cases to the number of workers exposed to risk, but it is probably fair and safe to say that the number of persons employed and exposed to risk has not been less, and has increased at a no less equal rate from 1939 in comparison with 1914. If that is true, then the incidence is not greater than in the previous similar war period. The exposure to risk before the onset of symptoms, has varied from three weeks to six months among females and from three weeks to ten months among males. The average age of the 40 females affected since 1939 has been 30 years (19-49 years) and that of the 28 males in the same period 42½ years. The interesting lag period between the cessation of contact and the onset of jaundice has again been noted; seventeen cases showing varying lag periods up to thirteen and a half weeks. Of the 475 cases between 1916 (when statutory notification of toxic jaundice came into force) and the end of 1941, 125 or 26.3% have ended fatally, the male death-rate being 21.9% and the female death-rate 28.4%.

The occurrence of anæmia of the aplastic type is also of interest. Up to February of this year we have had knowledge of nine cases of anæmia amongst T.N.T. workers, three of which were associated with jaundice. On March 1 of this year toxic anæmia

was made notifiable under the Factories Act.

Furthermore, we must not lose sight of the fact that in addition to known toxic liver damage, cases of liver damage occur in industry without evidence of contact with any chemical substance. Such cases should be studied carefully, as they may be of

value in analysing the factors determining liver damage in known toxic cases.

In 1917, Moore showed to our then satisfaction, that the skin was the main channel of absorption, and Legge, at the end of the last war, anticipated little risk in T.N.T. poisoning in the future, because he, optimistically, visualized the elimination of hand The T.N.T. is eliminated in the urine and its presence can be shown by Webster's test, but this unfortunately gives no indication of liver damage, but only indicates contact. Early evidence (from a simple test) of such damage would be invaluable.

Finally, as regards the prevention of illness from T.N.T., I would summarize this as cleanliness of the air breathed, secured by effective ventilation or, failing the practicability of that, filtration through an effective respirator, cleanliness of the implements used and the cleanliness of the person, secured by protective clothing and by personal attention to the care of the skin.

Dr. Catherine Swanston: Incidence of T.N.T. symptoms in a filling factory (Abridged).-Pure T.N.T. is used either molten, powdered, or as a biscuit. It is also

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used mixed with other substances, such as ammonium nitrate in amatol and with barium nitrate in baratol and many other mixtures. Contact hazard may therefore exist, either from T.N.T., dust or fumes, according to the process under consideration.

Dust hazard is met with in the preparation of amatol and baratol, aerial bomb and trench mortar filling, and in the breaking of biscuit. This last process we considered as one of the most dangerous processes in the factory. Women were kept out of it as far as possible, and we attempted, not too successfully, a rota system, limiting the time spent in this process by the workers. Later, coloured men worked on this job and whatever the reason, we have never had a case of dermatitis or T.N.T. illness on one of these workers. They appear to stand up to it amazingly well.

Fume hazard occurs where T.N.T. is melted and the temperature of the shops is always above the optimal. It also occurs where shells and anti-tank mines are filled.

In all the above processes there is, to a greater or lesser extent, direct skin contact with solid T.N.T.—spilled on the benches, allowed to cool, handled as biscuit, adhering to stemming rods, pouring cans, funnels, &c. Also the cleaning of these tools and shops themselves, unless done properly and under supervision, very often entails a higher contact than the filling itself.

T.N.T. is mainly absorbed through the skin, but working as at present, in ill-ventilated shops with dust and fumes constantly present in the air, a certain amount must be inspired into the lungs and ingested into the alimentary tract. Nevertheless, the skin is the most important absorbing surface in considering suitable protective clothing and safe methods of working.

In one factory about 2,000 persons are employed on T.N.T. work, three-quarters of them women. The ages of the women vary from 20 to 50 years, the men up to 60. Very few have done this work before. The general physical standard is low, especially among the men. Despite preliminary medical examinations, our standard must to a large extent depend on the state of the labour market.

The following are some of the conditions considered as an absolute bar to employment in T.N.T.: a history of jaundice or gall-stones, severe or chronic gastric illness, including gastric and duodenal ulcers, multiple or severe abdominal or pelvic operations, nephritis or nephrectomy, tuberculosis in any form, moderate or severe anaemia, chronic chest complaint, chronic skin lesions, or previous trade dermatitis, rheumatic fever and Graves' disease.

These workers are inspected twice in three weeks by the medical officer, on two of every three shifts. The shops are also visited, and the workers watched while on their jobs. Inspection of night shifts is valueless, cyanosis and early jaundice cannot be seen in artificial light.

The T.N.T. section was the first to go into production and labour was drafted there rapidly from the beginning. As a result, twelve to eighteen months ago, there was a large unsalted population in these shops, and this may partly explain the many cases of T.N.T. poisoning of that period. During the twelve months ending 31.12.41, we notified 495 cases of minor T.N.T. illness, including dermatitis, 15 cases of serious poisoning, comprising 12 of toxic jaundice and 3 of aplastic anaemia, one of whom had previously had an attack of toxic jaundice, from which she had apparently recovered. All our aplastic cases died, and three of our jaundice cases, i.e. 6 deaths, a 40% mortality. The sex incidence was 1 male to 14 females. The only male case had been employed exclusively for two months in sieving T.N.T. by hand.

The minor cases can be summarized as follows:

Anilism Gastritis Dermatitis	***	***	 ***	***	***	49 24 92	132 83 115
			T	otals	***	165	330

These are appalling figures, representing 25% of the present strength, but I cannot give the true percentage incidence, as I have been unable to get accurate figures of the monthly increase in the T.N.T. population in 1941.

These cases arose in every part of the factory, and it is impossible to inculpate specifically any one process, but one of the most dangerous processes for the women is the anti-tank mine filling, where both solid and liquid T.N.T. is used. Ten of our scrious cases came from these shops, 4 had worked exclusively on the job and of the 4, 3 died. The hands of such girls became very deeply stained and "filling mines" occurs more frequently than anything else in our case-histories. Among the men the filling of aerial bombs with amatol caused a great deal of minor illness, and many cases of dermatitis.

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In both these jobs contact is very heavy and, at that time as well, workers were inadequately supplied with the proper tools and ventilation was non-existent.

All these cases were removed from T.N.T. work, as soon as they were spotted, a few permanently, but the majority were allowed to return after a spell of non-contact varying from a few weeks to several months. In some of these, symptoms recurred, and they were taken off for good. In such cases Webster's test is of little value; all it means when positive is that T.N.T. is being absorbed and excreted and until we have an accurate simple test to show damage to liver or bone marrow, the moving of workers out and back to contact will remain a hit and miss affair.

Of the 495 cases notified, only a few were ill enough to be off work altogether. These

								Male	Female
(1)	Anilism	0 = 0			* ***	***		6	5
(2)	Dermatitis	***	***	***	***	***	***	10	9
(3)	Gastritis	0 0 0	***	400	***	000	0.00	1	2
					Te	otals	***	17	16

None of these cases was allowed to return to T.N.T. work. We felt that in these cases, except perhaps in those with dermatitis, there was a possibility of a higher degree of liver involvement and we could not risk further damage.

Dermatitis has been rather overlooked in the consideration of T.N.T. illness, but the average time lost by men and women in my series, was forty-eight and thirty-nine days respectively, a serious loss to production. Nineteen of the above 33 workers drawing compensation for minor T.N.T. illness, had dermatitis. Only very occasionally does one find a patient who has both a dermatitis and toxic symptoms together. I have only seen one case of jaundice with a confirmed T.N.T. rash.

The conditions under which these cases occurred were such as to facilitate the development of the pathological changes described. The shops were badly ventilated, and during black-out ventilation was non-existent. Later, lean-to's were built along one side of the units, open at each end, so that one door in every shop could be open always. Ventilation is, however, still not good, and there is a complete lack of local exhaust draughts to remove dust. Labour was raw, and rapid increase in production rendered inadequate the available supply of trained workers. But training shops are now being installed, and to these all new workers are drafted for seven to ten days. Here they work under constant supervision with adequate tools and following definite rules. Production in these shops has been known to beat that obtained in the shops where the old hands work.

Difficulties were accentuated by the lack of trained supervisors to appreciate the dangers of this work and to insist on clean methods of filling, and by the lack of proper tools for the different jobs. The inadequate supply of protective clothing was another important detrimental factor. Workers were forced to wear the same garment for weeks or even months after it had been soiled with T.N.T. This combined with inadequate ablution facilities, inadequate cleaning tools, and the lack of any proper system of cleaning benches and workshops, formed an unfavourable background for any reasonable regimen of cleanliness at work.

Improvements have occurred and are occurring. The above conditions are getting better and it is possible that now we have developed a salted population. Medical supervision has improved. In June 1941 a Minor Surgery was opened on the T.N.T. Section, staffed by trained nurses, with previous experience of T.N.T. illness, drafted from the Central Surgery. These nurses stick to their own shifts, and are encouraged to go through the shops, and they assist the medical officer at the routine inspection of workers. They do valuable work and have become skilled at assessing T.N.T. illness. Dealing with a small number of people they can exert a thorough and continuous supervision over their own shifts. They have been well received by the management, and by spotting early cases they have reduced the amount of illness. They have power to remove workers from contact, but not to put them back.

Much still remains to be done. Conditions in the shops can still be improved by more ventilation, local dust extraction, better tools and increased methods of machine filling. This last would reduce not only actual contact, but also the number of individuals exposed to risk and would increase production. Ablution facilities still require extending, and the supply of protective clothing could be improved. Further, a stricter supervision of the workers by people who are sufficiently intelligent and interested to appreciate the dangers of the work and the methods by which such can be avoided, is needed. Workers and supervisors ought to be trained to the job, and penalized (especially the latter) if rules are not obeyed.

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Dr. Ronald E. Lane: Clinical aspect (Abbreviated).—The clinical manifestations of T.N.T. poisoning may be summarized as follows: Dermatitis, Anilism, "Gastritis" Toxic Jaundice and Toxic Anæmia. The first three of these are comparatively frequently seen. Toxic jaundice is a serious and infrequent occurrence (0.2% in the last war), and toxic anæmia is an even rarer event.

Dermatitis.-None of the cases which I saw suffering from the other forms of T.N.T.

poisoning had ever had any T.N.T. dermatitis.

Anilism.—A great number of those in contact show minor and varying degrees of cyanosis. This is quite symptomless and is the result of T.N.T. absorption in these otherwise healthy-looking individuals. There is little or no pallor, and probably the cyanosis is due to a minor quantity of methæmoglobin in the blood. The more serious cases present the definite T.N.T. facies so well described recently by Roberts (1941), pallor, with a lilac coloration of the lips, and lobes and tips of the ears. It is lessened by excitement or mild exercise, and for this reason is best detected by the medical officer when in the departments during work rather than on any set medical parade. It seems probable that these changes are mainly vasomotor in origin. These cases in the early stages are usually quite symptomless. Later, in some cases, symptoms may develop, e.g. breathlessness, retrosternal tightness, with more or less malaise.

T.N.T. "Gastritis".-In this category three different types of case have been seen, and

their differential diagnoses are of practical importance.

(1) T.N.T. "Gastric illness": Here the patient complains of a dull ache in the epigastrium, unrelated to food and relieved by rest. These are the important cases which must be differentiated from the other groups, though this may occasionally be difficult. (2) Anilism with retrosternal pressure—sometimes described by the patient as

"indigestion'

(3) The group of chronic dyspeptics, whose symptoms may be aggravated by the long

hours without food, difficult journeys, and "shift" arrangements.

The true T.N.T. case usually gives no previous history of digestive trouble. He looks ill and very wretched and usually has the T.N.T. facies with marked pallor and looks "pinched" about the nose. He is weary, tired and intensely miserable. His loss of appetite is very marked. He is constipated, and his nausea and vomiting may be quite unrelated to food. Further, his heavy epigastric ache is quite unlike anything found in the ordinary dyspepsias. I believe these cases to be of hepatic origin, and therefore I consider their early detection of great importance. In half of my cases falling into this group the liver was enlarged and tender. Investigations disclosed little. Levulose tolerance tests were usually normal. Barium and fractional test meals disclosed no definite departures from normal. Blood examinations showed no abnormality. The urinary coproporphyrin content, however, was definitely raised in over half of the cases in which this estimation was made.

The treatment here, as in any industrial poisoning of this type, must start with the immediate arrest of intake of the poison. This means not only the removal of the patient from contact, but the removal of all T.N.T. from the skin of the patient. For this reason he is best removed immediately from his home surroundings into hospital, where a thorough bath is followed, as recommended by Moore, by the scrubbing of hands, fingers, feet and toes with ether until no pink reaction is obtained with alkaline alcohol. The nails should be closely cut. Bowels should be moved as soon as possible and kept open. A bland simple diet is allowed as soon as it can be tolerated. Fluids are given in large quantities, with as much fresh fruit and vegetable as can be obtained. Fats are kept to a minimum. Ascorbic acid was given in doses of 100 mg, daily in some cases, but I can adduce no evidence that it has affected the course of the disease.

These cases usually clear up so far as their major symptoms are concerned after a few days' rest in bed. In a few of the worst cases it has taken two or three weeks before they have been sufficiently free from symptoms to get up. In nearly all cases, however, the fatigue has hung on, and it is almost always the last to clear. These cases of true

T.N.T. gastric illness should never be allowed to return to contact.

Toxic jaundice.—This is fortunately rare. In this series eight of these cases have arisen (five female and three male) with two deaths. This preponderance among the females is well recognized, and is even better demonstrated in a series already partly reported by

Evans, 1941, for which details I am indebted to Dr. Swanston.

I know of no explanation for this difference in susceptibility, though it is a well-known finding with other industrial poisons. Is it in any way connected with possible thyroid dysfunction? The few B.M.R. investigations so far carried out in these cases have shown no very striking results. Or is it connected with dietary habits? Work so far published would lead one to believe that liver damage is best withstood on a diet low in fat but

high in protein and carbohydrate. In view of this one might question the advisability of giving extra milk to these workers. Perhaps skim milk might better serve their needs. Jaundice usually appeared after short exposure—in most cases less than three months. It was usually preceded by symptoms similar to those just described, though in half the cases there was no history of previous cyanosis. There is little remarkable about the dinical findings or investigations. Stools were usually light coloured—urine dark. The liver was palpable at some stage of the illness in most of the cases. In some it was soft and tender in the early stages, and in three cases it became hard and of an indiarubber consistency towards the end of the illness. All cases were apyrexial. Serum bilirubin values fell between 2 and 15 mg.%. Levulose tolerance tests were abnormal in only two cases. One feels the lack of a simple yet comprehensive test of liver function. The colour-index was above 1 in half the cases. The one investigation which showed a definite departure from normal was the urinary copro-porphyrin. In the two fatal cases this figure was some 50 times greater than normal. The estimation was carried out immediately the patient was admitted to hospital some weeks before death and is therefore a striking finding.

Diagnosis: I know of no way in which these cases can be differentiated with certainty from catarrhal jaundice resulting from an infective hepatitis. These latter cases usually show some pyrexia for a week or two, but pyrexia is occasionally reported in the toxic cases. The only course open to us is to regard all "jaundice" among T.N.T. workers as of

toxic origin, excepting always, of course, the obvious surgical cases.

Treatment: The treatment of toxic jaundice was on similar lines to that given in toxic gastric illness: admission to hospital, thorough cleansing, saline aperients, fluids and a high carbohydrate diet low in fat with high vitamin B and C intake. Zinc insulin (15 units daily) was given with a view to increasing glycogen storage and possibly producing an increase in glycuronic acid, which is needed in one of the detoxicating mechanisms for dealing with T.N.T. Whether or not any better results have been obtained as a result of this, I am not prepared to say.

Course: Of the six patients who survived in my series four have so far returned to work after an illness of approximately four months. In all cases unusual fatigue is the

most persistent symptom. Recovery probably brings some measure of cirrhosis.

Aplastic anamia.—Three cases of aplastic anamia due to T.N.T. poisoning have been included in this series. All are in men—one of 41, one 51 and one of 55 years of age. Each case presented a similar picture—a profound normocytic anamia associated with agranulocytosis and a low platelet count, all blood-forming elements being affected. Although there was no reason to suppose it would be successful, liver and nucleotide therapy was attempted without result. The only measure which met with any success was repeated transfusion. In this way our first case was kept alive for some months until his marrow began to regenerate. It is now some nine months since the beginning of his illness and four months since his last transfusion, since which he has not only retained his red count, but has increased his hæmoglobin by 20%. His white count remains in the neighbourhood of 6,000, with a normal differential count, and his platelets have also returned to normal. The patient has still an enlarged liver, and over the last few months his spleen has become palpable. I believe this to be the first case of aplastic anamia due to T.N.T. to survive. These are desperate cases, but there is hope that in the less acute cases life may be saved by repeated transfusion. The two other cases are still under treatment.

One other case has given rise to considerable interest, particularly in view of the recent work of Bomford and Rhoads, 1941. A woman with pernicious anæmia, who had been heavily exposed to T.N.T., has failed to respond normally to liver therapy, despite the fact that she has been on large doses of an active preparation. Has T.N.T. been responsible for this, and, if so, is there in all these serious T.N.T. cases some conditioning process

rendering the individual susceptible to the effects of T.N.T.?

Copro-porphyrin estimations.—From a strictly practical point of view the prevention and care of the minor cases in the factory is more important than the supervision of the more serious type of case. There is so little we can do for these latter that every effort must be made to secure their prevention. One of our chief weapons is medical supervision in the factory. This is no easy task, but it would be greatly lightened if it were possible to evolve an objective test which would enable a closer control to be exercised on those exposed to the T.N.T. hazard.

Some assistance might be gained from urinary copro-porphyrin estimations. In Table I are given results so far obtained. In this work I have been fortunate in securing the assistance of Dr. Kench, who has made all these estimations for me. It will be seen that there is a considerable rise in most of the T.N.T. cases as one would expect from the

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TABLE I .- URINARY COPRO-PORPHYRIN PER LITRE

G	astritie	0,84	000	610	800	***	F. M. M. F. F. M. M. M. M.	Age μ 47 36 41 49 55 37 38 54 58	g per 24 hours 84 - 33 93 61 153 31 130 234 50	
A	nilism ·	***	***	***	***		M. F.	65 50	202 84	
T	ozic jaundice			***	* Done	***	M. M. F. F.	62 28 42 24 24	1,904* 212 1,376* 150 320	

work of Rimington and Goldblatt, 1940. The series is certainly far too small, but the findings in the fatal cases are arresting.

#### REFERENCE

BOMFORD, R. R., and RHOADS, C. P. (1941), Quart. J. Med., 10, 139. EVANS, R. M. (1941), Lancet (ii), 552. RIMINGTON, C., and GOLDBLATT, M. W. (1940), Lancet (i), 73. ROBERTS, H. M. (1941), Brit. M. J. (ii), 647.

Professor T. B. Davie (George Holt Professor of Pathology, University of Liverpool): The pathology of T.N.T. poisoning.—The lesions associated with the action of T.N.T. may be classified as follows: (A) Direct effects on the blood: (1) Reduction of O<sub>2</sub> – carrying capacity by formation of some methæmoglobin and NO-hæmoglobin. (2) Hyperplasia of marrow (compensatory to above). (B) Local toxic effects: (1) Skin—dermatitis. (2) Mouth and pharynx—edema glottidis. (3) Gastric mucosa—catarrhal gastritis. (4) Subcutaneous—necrosis (experimental). (C) Severer systemic effects: (1) Liver—toxic necrosis. (2) Marrow—aplastic anæmia. (3) Vascular endothelium—acute toxic purpura. (4) Other organs, e.g. kidneys—relatively mild degenerative changes.

(4) Other organs, e.g. kidneys—relatively mild degenerative changes.

Direct effects on the blood.—The clinical evidences of anilism have always been the first obvious signs of absorption of T.N.T. Benjamin Moore (1917) made much of the oxygen lack resulting from the replacement of some of the oxyhemoglobin by methæmoglobin and nitro-hæmoglobin. Panton (1917) in his earliest investigations on these cyanosed patients and again in his M.R.C. Report (1921), drew attention to a mild reactive leucocytosis, affecting mainly the neutrophil polymorphonuclears, but stressed the absence of anæmia in the cases of anilism. His records show R.B.C. counts which to-day would be regarded as somewhat above normal. The only reference to reticulocyte counts is to be found in the post-war report on the American investigations by Minot (1919). He found them increased in the few cases examined, and incidentally also observed the presence of polychromasic red cells in 83% of a series of 233 workers.

We have been able to confirm this stimulant effect on the marrow in an investigation on the reticulocyte counts of small groups of new workers and old hands in the ordnance factory.

One of these groups comprised eight new workers, the average of whose reticulocytes before starting work was 5-9 per 1,000 red blood cells. During their first month of contact work counts taken at ten-day intervals showed increases in every case, the average count at the end of the month being more than doubled, to 12-2 per 1,000 red blood cells. This effect was also shown in another series consisting of workers who had been in contact operations for periods ranging from eight to fifteen months without developing symptoms necessitating their removal from contact work. The reticulocyte count of these eight varied from 5 to 26 per 1,000 red blood cells with an average of 13. This figure though within the normal range is probably about double the normal average.

Local irritative effects.—Among the local toxic effects of T.N.T. seen in our ordnance factories, the two commoner manifestations present little of pathological interest. The dermatitis is usually papular; the other common lesion, gastritis, is presumed to be associated with a catarrh of the gastric mucous membrane. Gastroscopy has not yet, to my knowledge, been employed to elucidate the pathology of this condition.

The serious complication of cedema glottidis was reported on a few occasions during the last war, but thus far it has not been reported in the factories in our area.

Severe systemic effects.—It is, however, with the grave systemic manifestations of T.N.T. poisoning that we are primarily concerned. The features of these toxic onslaughts were described in detail and with great accuracy by Stewart, Turnbull, Panton and others

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in the discussion arranged by this Society and reported in its Proceedings in 1917, 10,

Between 1921 and 1940 no publication of note on this subject has appeared. Recent articles by Hilton and Swanston (1941), Roberts (1941) and Evans (1941) have indicated that the cases occurring at present are of the same type as those of 1916-18. Now, as in the last war, the majority of the fatalities succumb to acute liver necrosis (or acute yellow atrophy), a small proportion die of an aplastic anæmia, and an occasional one

manifests the features of an acute toxic purpura.

Toxic jaundice.—The changes in the liver are those of widespread necrosis which may, in the course of a few days, reduce the liver to half or even a third of its normal weight. The hepatic cells not destroyed are deeply bile stained and show up as yellow patches in a dull red field, particularly in the subacute cases. The red areas are those where necrosis has been complete and the red blood corpuscles from the disrupted sinusoids mingle with fatty fragments of liver cells and necrotic debris. In the subacute cases the necrotic areas are not so extensive and show ingrowths of fibroblasts and new capillary loops into the necrosed tissue. This highly vascular tissue is often bright red in colour and contrasts sharply with the jaundiced remains of liver parenchyma. Among the surviving liver cells are to be seen all grades of degenerative change. This is interpreted as indicating that the noxious agent is continuously at work. In all but the most acute cases there is evidence of chronic inflammatory cellular (lymphocytic) reaction and of regenerative proliferation of both bile duct epithelium and hepatic cells. The hyperplasia of the bile ducts leads to their appearance in great numbers in the necrotic areas, while that of the hepatic cells is seen first in the appearance of large active cells at the periphery of the surviving liver cells and later by marked nodular masses of liver cells with poorly demarcated lobular pattern. This nodular overgrowth is accentuated by the contraction of the fibrous tissue which eventually replaces the necrosed tissue. The outcome is the condition known as multiple nodular hyperplasia, seen to best advantage in those cases dying of aplastic anæmia, or other cause, some months after recovery from an attack of toxic jaundice.

The various features of the pathology of the liver have been exemplified in the present series of fatal cases. Three of them (A. H., J. T., and E. C.) showed acute liver necrosis; one (M. D.) presented the picture of a subacute attack and one (R. W.) showed typical multiple nodular hyperplasia when she died of aplastic anæmia four months after her

attack of toxic jaundice.

This liver necrosis has defied all efforts to produce it experimentally in animals: its exact mode of production is thus still a mystery. Also unexplained are the reasons for its very low incidence among the large numbers of workers exposed apparently to the same hazards; for its occurrence in individual factories in waves resembling epidemics of infection, and for the variable latent period even in the susceptible.

				TABLE			
Name	Sex	Age	Cause of death	Liver appearance	Wt. g.	Marrow	Petechiæ
A. H. J. T. R. W.	F. F. F.	23 21 35	Toxic jaundice Toxic jaundice Aplestic anæm.	Acute necrosis Acute necrosis Subac. necr. No jaundice, A.Y.A.	680 620 1150	Not examined Hyperplastic +++ Hyperplastic ++	+ + + +
A. B.	F.	21	Aplastic anæm.	Subac. necr. Jaundiced	1250	Aplastic	++
R. B.	F.	23	Acute toxic purp.	Early necr. No iaundice	1500	Hyperplastic +++	+++
E. C. M. D.	F. F.	39 32	Toxic jaundice Toxic jaundice	Acute necrosis Subacute necrosis	530 635 ,	Hyperplastic +	-3

A.Y.A. = Acute yellow atrophy 5 months previously.

Aplastic anæmia.—Aplastic anæmia is much rarer than toxic jaundice. In the last war there were only 15 cases, all fatal, as compared with 404 cases including 106 fatalities from toxic jaundice. From the reported accounts of these cases it is apparent that while in some there was aplasia of all the hæmopoietic elements—erythropoietic and granulopoietic—in others the leucopoietic elements were unaffected. In the few cases which have been reported so far in this war the same appears to be the case. Our first fatal case (A. B.) showed an R.B.C. count of 1·5 million and a total leucocyte count of 1,000 per c.mm. of which only 4% were neutrophil polymorphonuclears. The marrow of femur and ribs showed no hæmopoietic tissue at post-mortem and there was very little red marrow in the sternum. The second fatal case (R. W.) also showed a severe agranulocytosis coincident with the aplasia of erythropoietic tissue, but at post-mortem there was found an unexpected hyperplasia of the marrow in both femur and ribs. Smears of this red marrow from the middle of the shaft of the femur showed an almost complete absence of leucocytes and myelocytes and of primary or secondary erythroblasts. The only cells

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present, apart from some lymphocytes, were hæmocytoblasts. As this particular case had recovered, some four months earlier, from a severe attack of toxic jaundice, and as at post-mortem the liver showed the result of this in the form of a multiple nodular hyperplasia, Evans (1941) who reported the case was led to suggest that the earlier damage to the liver may have repressed the formation or the storage of some maturation principle necessary for normal hæmopoiesis.

A third case (M. S.) of aplastic anæmia was admitted to another hospital in January of this year. Although her red cell count had been as low as 730,000 per c.mm. this woman is still alive, largely, we believe, as the result of repeated transfusions, of whole blood at first, and later of concentrated suspensions of R.B.C. In her case the aplasia affected mainly the erythropoietic tissues and her reticulocyte counts had remained at zero for some time, though latterly there had been some response. Her white cell count was at first slightly below normal limits but latterly has been maintained at an average of about 6,000 per c.mm. She cannot at present be regarded as fully cured, but there appears to be at least a chance that she may recover.

Acute toxic purpura.—The last case in my series (R, B.) died at home without any hæmatological or other examinations prior to death. At post-mortem she presented the features of purpura hæmorrhagica except that there was no splenomegaly. There was certainly no apparent anæmia and to naked-eye examination her liver appeared normal. Microscopically however the liver showed very early acute necrosis. Her marrow was markedly hyperplastic, the femur containing red marrow throughout the upper threequarters of its length, and microscopically all the elements of the marrow were represented.

#### DISCUSSION

From a study of these seven cases it appears that in all of them the liver, the marrow and the vascular endothelium are affected simultaneously by the toxic action of T.N.T., though in different degrees. For reasons which are not clear the attack in some cases destroys the liver and, though affecting the marrow to the extent of calling forth an erythroblastic response, produces little or no anæmia. The vascular endothelium in these is damaged sufficiently to produce a variable number of petechiæ. In other cases the toxic effect falls most heavily on the marrow, usually repressing both the erythropoietic and the leucopoietic elements, but sometimes only the former. In these the liver is damaged even to the extent of a subacute necrosis with accompanying jaundice, and the vascular endothelium almost inevitably suffers both by direct toxic action and by the anæmic anoxia. In still others, and these are the rarest, the brunt of the attack is borne by the vascular endothelium. These develop an acute toxic purpura, but their marrow and liver are both affected to some extent.

It seems unlikely that the apparently selective effect on these different organs and tissues is due to differences in the type of the noxious agent. To dismiss the subject by assuming an inherent susceptibility of particular tissues to the toxic action of T.N.T. in different patients is to close the door to further inquiry. Acquired differences in tissue susceptibility is a more acceptable explanation, but as yet there are few if any clues as to the factors determining these variations.

#### FUTURE RESEARCH

Further inquiry into the problem of T.N.T. poisoning is undoubtedly called for. It is probably no exaggeration to say that in this war insufficient attention has been paid to the lessons learnt by bitter experience in our ordnance factories in the last war; but even when we are assured that all that was learnt in the last war is being applied fully and wisely, there is still obvious and urgent need for immediate and extensive investigation. Team work of whole-time investigators at or near the actual ordnance factories offers the greatest hope of successful research. These investigators should further have the benefit of the assured assistance of both medical and non-medical specialists, particularly physicists and biochemists, but the direction of the research should, I believe, be in the hands of a clinician. Part-time or financially starved research at this stage would be a disgrace to the country and a waste of effort on the part of the majority of those undertaking it.

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# Section of Radiology

President-M. H. JUPE, D.M.R.E.

[March 20, 1942]

# DISCUSSION ON THE PLACE OF RADIOTHERAPY IN THE TREATMENT OF THYROTOXICOSIS

Dr. Laurence Martin: I have had the opportunity, while studying thyrotoxicosis in general, of following up a series of cases treated by X-rays at Addenbrooke's Hospital, Cambridge, by Dr. Ff. Roberts. The full results of this follow-up study have recently been published (Martin, 1942) and I shall only refer to some of the important points.

Reports from radiotherapists on X-ray therapy for thyrotoxicosis have tended to be over-enthusiastic, very technical, and often lacking in sufficient clinical details of the cases treated; surgeons have sometimes condemned X-ray therapy on insufficient grounds and over-emphasized the risk of scarring in the neck, while physicians—bewildered by the conflicting opinions—have fought shy of the treatment because they were not told exactly which types of thyrotoxicosis responded well, and which were unsuitable.

It seemed essential, therefore, for any follow-up study to aim at a precise description of the cases treated and a full discussion of the results obtained in the various types of thyrotoxicosis. In this way alone could the value and limitations of X-ray therapy be assessed. I was able to see 40 cases treated by Dr. Roberts in the years 1927-1938 inclusive, and two treated previously by Dr. Shillington Scales. 32 were females, 10 males, and the average age at time of treatment was 35 years, with extremes of 73 and 16 years. The follow-up interval varied from a maximum of fourteen years to a minimum of three years. The series consisted of the following types of case: Primary mild 5, primary moderate 22, primary severe 4, secondary mild 1, secondary moderate 1, secondary severe 5, and non-toxic goitre 4. The following grading of results was used at the follow-up:

Grade I.—Full ability to resume normal life or work without remaining symptoms.

Grade Ia.—As for Grade I but with some disability such as hypertension, diabetes or hypothyroidism not causing restriction of life or work.

Grade 11.- Improved -- but with some restriction of work or activity.

Grade III.—Invalidism.

The results obtained were as follows:

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		CHALLEY	T' LEV TA	OFFCA	-01.		
Type		1	Ia	II	III	Dead	Total
Primary, mild		1	2	2	0	0	5
Primary, moderate		28	5	7	0	2	99
Primary, severe		3	0	1	0	0	4
Secondary, mild		0	0	1	0	0	1
Secondary, moderat	e	0	1	0	0	0	1
Secondary, severe		0	0	0	1	4	5
Total (toxic cases)		12	8	11	1	6	38
Non-toxic goitre		0	0	4	0	0	4
Total (all cases)		12	8	15	1	6	42

This shows that of 31 cases of primary thyrotoxicosis 19 or 61% were in Grades I or Ia and could be considered as cured of thyrotoxicosis although the 7 cases in Grade Ia had some other disability. 10 cases (32%) were improved but restricted in activity. 2 cases were dead—one of pneumonia a year after treatment and the other of rheumatic carditis, during the course of which she had developed thyrotoxicosis. Of the 7 cases of secondary thyrotoxicosis only one could be considered as cured, and she had hypothyroidism; 4 were dead, one was bedridden and one restricted in life.

The four cases of non-toxic goitre with neuroses or autonomic imbalance were not improved.

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These results show clearly that X-ray therapy has no place in the treatment of secondary thyrotoxicosis or toxic nodular goitre. The melancholy results recorded here, when contrasted with the brilliant results of surgery in this type of thyrotoxicosis allow of no other conclusion. Admittedly 5 of the 7 secondary cases were severe and 4 had auricular fibrillation and heart failure, but they did not respond to X-ray therapy and 3 of them died after thyroidectomy undertaken as a desperate measure.

Mild and moderate cases of secondary thyrotoxicosis, however, are prone, untreated, to progress inexorably to thyrotoxic heart failure—although this may be a slow process and I have been unable to find in the literature any unequivocal statement that X-ray therapy can either cure or prevent thyrotoxic heart failure or auricular fibrillation. Such patients therefore should not be lulled into false security by X-ray therapy when they cannot be guaranteed the same immunity from cardiac damage which is provided by thyroidectomy. Furthermore a patient with a nodular goitre may, at any time, get tracheal compression and urgent dyspnoa from the hamorrhagic enlargement of a nodule, and there is no evidence that X-rays can protect from such a mechanical disaster. I consider, therefore, that cases of secondary thyrotoxicosis or toxic nodular goitre should be treated by surgery alone. This, in effect, means that the decision whether a case of thyrotoxicosis is primary or secondary is of fundamental importance. The decision may sometimes be clinically difficult or even impossible, and I think it is then better to advise surgery, thus removing any doubts about the future of the patient's heart. Another point is that relief of thyrotoxic symptoms in 19 of 31 (61%) primary cases, and improvement in a further 10 cases show that X-ray therapy can compare favourably with surgical results. There were only 4 severe primary cases, and although three did well and one was improved, the numbers do not justify any dogmatic statement. We know the dire peril in which such patients live-with the constant threat of crisis and cardiac or mental breakdown hanging over them-and the decision for X-rays or surgery must be entirely individual.

In the moderate primary cases—probably the commonest type seen—X-rays removed thyrotoxic symptoms in 13 of 22 cases (59%) and caused improvement in 7 (33%).

Autonomic imbalance.—It is with mild primary cases, borderline cases and cases of pure autonomic imbalance that I do not think X-rays can be expected to do very much when their nature is considered. If thyrotoxicosis be regarded as having two main components—namely thyroid dysfunction grafted on a basic constitutional nervous instability—then the mild and borderline cases are those with minimal thyroid dysfunction and maximal nervous instability, while true cases of autonomic imbalance have no thyroid over-activity at all. An attack on the thyroid by surgery or X-rays can only do the same thing—namely to remove the minimal thyroid component and leave untouched the nervous instability which is causing most of the symptoms.

It is true that some cases of pure autonomic imbalance improve with X-ray therapy, but we cannot exclude this as being the result of suggestion for these patients improve equally with medical treatment and more orthodox psychotherapy. I have no large series of cases of autonomic imbalance to substantiate this view, although it is supported in the literature, but I have reported on a small series (Martin, 1939). There were 13 cases, of whom 2 had been treated by X-rays and one by thyroidectomy without improvement, while 7 of the remaining 10 cases were doing well with psychotherapy and symptomatic medical treatment. I feel that they are best treated at present in this way until the nature of their disability is better understood.

Only 7 cases in this series were treated by both X-rays and surgery—3 of them, already mentioned, had thyroidectomy as a desperate measure with fatal outcome after failure to respond to X-rays. One patient who relapsed after a hemithyroidectomy did well with X-rays and the remaining 3 were really unsuitable, being patients with residual neuroses and anxiety states after operation.

Hypothyroidism developed in 6 (14%) of the 42 cases of this series. In 4 it could be directly attributed to the X-rays as it was associated with keloid scarring of the neck and came on early. These cases, however, were amongst the very earliest treated and no scarring has occurred since adjustments in Dr. Roberts' technique at that time. One patient developed myxcedema some years after the end of treatment and another had a striking phase of myxcedema lasting a year soon after treatment, only to be followed by a relapse of thyrotoxicosis for which he was again treated by X-rays. This last patient was the only one in the series who relapsed after apparent cure.

Progress.—I cannot speak of the progress during treatment of the cases in the follow-up series, but I have observed other patients during that period. Improvement seems generally to occur in the following sequence—decrease in nervousness and sweating, increase in strength and energy, gain in weight and decrease in appetite. The pulse-rate

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drops steadily, but still retains its lability on emotion and exertion which is probably a manifestation of the underlying nervous instability and not of thyroid dysfunction. The goitres diminished in size rapidly but exophthalmos, as after thyroidectomy, was very variable in its disappearance and seldom did so completely. The patient's own estimate of improvement has been particularly reliable, and those who insisted that they were no better were usually very mild cases or examples of autonomic imbalance.

With Dr. Roberts' technique, treatment usually occupied an average of six months including periods of rest to avoid producing telangiectases or for observation, and this was regarded as a minimum period of incapacity. In general, normal life was resumed in twelve to eighteen months. It was very striking that improvement continued after cessation of X-ray therapy sometimes for a further six to nine months. It is evident that no definite rules can be laid down for rate of progress in each case.

Three cardinal points must be emphasized:

(i) Every case of thyrotoxicosis is an individual problem, and there is a place for medicine, surgery, X-rays and psychotherapy in treatment of the various types. There is no panacea for thyrotoxicosis and only by skilful decisions can the best results be obtained from the various forms of treatment.

(ii) No attempt has been made to compare the relative merits of X-rays or surgery in cases suitable for either method. The decision rests entirely on individual factors such as the surgical and radiotherapeutic facilities available, and the economic position

and wishes of the patient.

(iii) Surgery and X-rays can only do the same thing by different methods—namely removal of the thyroid component of thyrotoxicosis—and a patient upon whom thyroidectomy would confer no benefit, would also derive none from X-ray therapy.

### Suggested Indications

(i) Primary thyrotoxicosis of such a degree that severity does not demand early operation, nor its mildness suggest autonomic imbalance rather than true thyrotoxicosis.

(ii) Primary thyrotoxicosis in children and adolescents in whom one is reluctant to

advise removal of a valuable endocrine gland during the growth period.

(iii) Cases of primary thyrotoxicosis in whom thyroidectomy has been followed by relapse.

(iv) Patients with primary thyrotoxicosis who refuse operation, or whose dread of it

threatens mental breakdown.

#### Contra-indications

(i) Cases of secondary thyrotoxicosis or toxic nodular goitre.

(ii) Primary or secondary thyrotoxicosis with cardiac failure or auricular fibrillation paroxysmal or established).

(iii) Where the goitre causes tracheal compression or displacement, and retrosternal goitre.

(iv) Where the diagnosis of thyrotoxicosis is doubtful.

(v) Where the fundamental decision cannot be made as to whether the thyrotoxicosis is primary or secondary.

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Mr. Frank Ellis: This paper is based on 91 cases referred to me for radiation treatment for thyrotoxicosis from 1931-41. Of these 3 were treated successfully by operation before radiotherapy was instituted and two were cases of carcinoma found at operation for thyrotoxicosis and treated by radium for recurrence in the scar. These cases are not included in the discussion. In addition to these 4 cases have not been followed up, leaving 82 cases to form the basis of this paper.

The patients were all referred through consulting surgeons or physicians, radiation being preferred to surgery because of the case being so slight or so severe that operation was not considered justifiable (although in one case operation was refused) or because, having

had one or even two operations the patient still suffered from thyrotoxicosis.

Besides the 4 not followed up there were 9 patients who were not medically examined during the past month. The other 78 were all examined for this meeting by 2 colleagues and myself. The analyses included in this paper were made from the clinical notes on a special form completed as far as the facts would allow.

Of the 82 patients treated by radiation and followed up, 54 were classified as cases

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of primary thyrotoxicosis and 28 as cases of secondary thyrotoxicosis. This division was found to be difficult. The primary cases were mostly young, with definite exophthalmos, no cardiac irregularity, not necessarily having lost much weight, but suffering greatly from nervous symptoms and having a uniform smooth goitre. The secondary cases were generally at the menopausal age, with less tendency to exophthalmos, higher incidence of cardiac irregularity, great loss of weight and irregular or slight goitre.

Cases free from thyrotoxicosis are described as cured. Cases with slight symptoms

of thyrotoxicosis are said to be improved.

To assess the place of radiotherapy in the treatment of thyrotoxicosis, the following points must be considered:

#### (1) The Influence of Radiotherapy on Thyrotoxicosis

This can be ascertained by assessing the results in cases treated by radiotherapy alone, or after surgery. In the group of cases of primary thyrotoxicosis 50 came under the heading of which 37 were cured and 13 were improved. In the group of secondary thyrotoxicosis were 21 cases of the 28 filling this condition and of these 10 were cured,

TABLE 1.-CASES TREATED BY RADIOTHERAPY ALONE OR AFTER SURGERY.

Primary thyrotoxiconis (54 cases).		Secondary thyrotoxicosis (28 cases).
50 so treated 37 cured		21 so treated 10 cured = 48%
13 improved	. = 26%	6 improved = 28%
		3 unchanged = 14%
,		1 worse = 5%
		1 died (cerebral) = 5%

6 improved, 3 unchanged and one made worse, while one died after ten days' radium treatment of a cerebral embolus or thrombosis, having had a similar cerebral attack before admission to hospital. Thus in the primary group all were improved and 74% cured, while in the secondary group 48% were cured and 28% only improved. Therefore radiotherapy can cure or improve most cases of thyrotoxicosis, but is more effective in the primary than the secondary type.

TABLE II.—INFLUENCE OF RADIATION ON SYMPTOMS AND SIGNS.

			Prim	arv.			Secondary						
		Bei SV			ter SL	Percentage	Bef			ter SL	Percentage		
			313	34				SL	34	3L			
		48	-	-	8	93	18	1	4	5	65		
Nervousness		48		_	11	88	16	-	2	4	75		
Parantina		47	-	_	9	90	14	1	2	1	65 75 83 53		
Zarambahalaraa		-35	5	-	24	69	7	1	2	3	53		
Dimmon		47		-	12	87	19	-	6	2	63		
		13	_	1	3	81	2	1	1	1	40		
Mann	***	33	-	2	3	90	5	3	3	2	48		
W7 and		44	5	-	7	93	16	1	- 3	5	67		
		12	-	3	4	71	-	-	_	-	-		
Diamboon		8	-	6	_	100	4	-	0	1	100		
Cardiac irregulari	ty	_		_	-		6	_	7	_	-16		
Slight =   Sever	e, í	or ass	essmen	t of pe	rcenta	ges.	SV =	Severe.		SL	= Slight.		

In connexion with this point I analysed the symptoms and signs with regard to the influence of radiotherapy. The figures are shown. The percentages are assessed by allowing a half each "slight" symptom or sign. Again the percentage "cure" of symptoms is high and better in primary than in secondary thyrotoxicosis, but in none of the 6 cases in the secondary group with cardiac irregularity was the irregularity cured and in one case auricular fibrillation developed after treatment.

#### (2) The Particular Factors Making for Success or Failure of Radiotherapy

This must be considered with regard to the patients and with regard to the treatment. It is intended here to deal with the former. The question of primary or secondary thyrotoxicosis has already been dealt with. The influence of sex and age has been investigated.

TABLE III.—CASES TREATED BY RADIOTHERAPY ALONE OR AFTER SURGERY.

		Influence	of Sex.		
Primary thyro	toxicosis.		Secondary	thyrotoxicosis.	
8 M. 42 F.	4 cured 33 cured	4 improved 9 improved	6 M.	3 cured	1 improved 2 unchanged
		· ·····	15 F.	7 cured 1 unchanged 1 died (cerebra	5 improved 1 worse

No significant influence of sex.

In the primary group of 8 males 4 were cured and 4 improved, while of 42 females, 33 were cured and 9 improved.

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In the secondary group of 6 males 3 were cured, 1 improved and 2 unchanged, while of 15 females 7 were cured, 5 improved, 1 unchanged, 1 worse and 1 died.

The differences are not significant.

The differences in results also according to age-groups are probably not significant.

Primary thyrotoxicosis.				Secondary	thyrotoxic	No			
Age Under 20 20 - 29	Cases 9 15	Cured 7	Improved	Age 40—49	Cases 4	Cured 2	Died Improved ch 1 (cerebral embolus)		
20 - 29 30 - 39 40 - 49	13 13	10 13	3	50—59 60—69	8 9	5	2 3	l 1	

In view of the small numbers, the only significant fact seems to be the increased cure rate in the older patients suffering from primary thyrotoxicosis. This high rate at least suggests that they have been assigned to the correct group.

It was thought possible that previous operation might influence results.

In the primary group 12 cases in which operations had failed showed a ratio of cured to improved of 6:6. With such small numbers this is not a significant difference from the ratio in the whole group and any lack of response may be due to the fact that the cases were particularly stubborn since surgery was unsuccessful. 2 cases in the secondary group were treated after operation and were both cured.

The severity of the thyrotoxicosis is obviously of considerable importance, but the records do not lend themselves easily to analysis on this point. My impression is, however, that the very severe cases are as likely to be completely cured as are the mild

cases, but they may require more treatment.

#### The Results of Radiotherapy Compared with Surgery

Neglecting in this section the question of operative mortality, it is safe to say that not all cases operated upon were cured because 14 of the 82 cases referred and treated were patients who had had partial thyroidectomy performed (twice in two patients).

#### TABLE IV.-CASES OPERATED UPON: PARTIAL THYROIDECTOMY.

111111111111111111111111111111111111111			242 40 8 42	Illian interior				
Primary thyrotoxicoxis.				Secondary thyrotoxicosis.				
10 54 Improved by radiotherapy Cured by radiotherapy	Before	Radioth	4	e. surgical failures. $\frac{2}{28} = 7\%$ Cured by radiotherapy	***	***	00 300	2
$\frac{5}{54} = 9.3\%$		kadiother		radiation failures. $\frac{7}{28} = 25\%$				
Cured by operation	***	*** ***	2	Cured by operation Improved by operation				1 6
Cured by further radiation Improved by further radiation		*** ***	1					

In the primary group there were 10 in whom operation failed and of these 6 were cured and 4 improved by operation. Of patients whom I referred back for operation because of the failure of radiotherapy 2 were still not cured by operation and further tadiotherapy cured 1 and improved the other. 1 patient was submitted to surgical interference without my knowledge only four weeks after a course of radium. She subsequently developed myxedema, but was cured of thyrotoxicosis. I do not class this as a failure of radiotherapy since sufficient time was not allowed.

In the secondary group only 2 cases were referred for radiotherapy after operation. Both were cured. 7 cases, however, were referred for operation after radiation had failed

to effect a cure. Of these 6 were improved and 1 cured.

The figures are shown in the accompanying table. It is obvious that there are fewer surgical failures in the secondary group and more radiation failures than in the primary group. This suggests that operation is more definitely curative in the secondary group. This group is the one in which the symptoms and signs are more definitely those of uncomplicated hyperthyroidism. For instance, there is less exophthalmos. The corollary to this is that the so-called secondary thyrotoxicosis is really primary thyrotoxicosis and that the thyrotoxicosis of the so-called primary group is a secondary phenomenon.

There was a possibility that the cures of surgery were better in quality than those of radiotherapy and this question was tested roughly by comparing the averages of the pulse-rate, weight and blood-pressure of the operated cases and those treated purely by

radiation.

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No statistical significance is claimed for the figures because of the small numbers of estimates available of conditions before treatment. In no instance is the result of radiotherapy inferior to that of surgery.

It must be remembered, however, that a large proportion of these figures represent surgical failures, but they were the only figures available.

						Blood-	-pressure			
	Pulse-rate		Weight		Diastolic		Systolic		Pulse pressure	
Primary:	В	A	В	A	В	A	B	A	В	A
Surgery	 119	92	7-7	9-0	-	94	determin	160		66
No surgery	 125	84	7-111	9-8	74	86	150	142	76	66 56
Secondary:										
Surgery	 110	85	7-4	9-0	97	94	193	170	94	76
No surgery	 123	96	6-7	9-10	92	95	180	164	88	69

I was under the impression that the effect of radiotherapy might be to reduce the pulse pressure by raising the diastolic rather than lowering the systolic pressure. The above figures do not support such an impression but the point needs investigating.

It is important to decide at what period the patient commences to improve and when the improvement attained may be considered complete. This question is dealt with in the analysis of the effects of technique.

### The Dangers of Radiotherapy Compared with those of Surgery

Danger of death is very remote as a direct result of radiotherapy. Most authors agree on this point, although Prüfer in 1931 reported 6 fatalities.

Of the patients concerned in this investigation 6 are dead. The only case in the primary group to die, did so five years after treatment from bronchopneumonia. She was free from thyrotoxic manifestations. Of the other 5, all in the secondary group, 2 died of myocarditis, one of diabetes mellitus, 1 of widespread metastases from carcinoma of the breast and 1 of cerebral embolus. The last was the only one in which treatment could be implicated as a possible cause and in this case it seems unlikely because she had suffered a similar attack at home before admission into hospital. It can definitely be accepted that the mortality of radiotherapy is less than that of surgery. This is partly because the acute crisis is a much more likely event following operation and as Joll remarks, there is no known panacea for the acute post-operative crisis. The other dangers of radiotherapy are, skin damage, myxœdema and cardiac degeneration due to delay in removing the toxic process, as a possible cause of avoidable damage to the heart muscle, but in this series of cases only I case has developed irregularity of the heart rhythm, whilst under observation. Against this, however, is the fact that none of the patients with cardiac irregularity was cured of it although this commonly happens after operation. Other complications such as respiratory infection and laryngitis have not occurred. Two patients who developed an acute crisis, both severe cases in the primary group, were controlled by iodine and intravenous saline. The operation is not rendered noticeably more difficult. 5 cases in the primary group and 7 in the secondary group operated on after radiotherapy all survived the operation and the wounds healed by first intention. The dangers of tetany and recurrent laryngeal nerve paralysis have not been mentioned in the literature as a possible result of radiotherapy and have certainly not occurred in this series. One other danger of operation to which radiotherapy is not liable is that of making further operation impossible, partial thyroidectomy makes a further operation much less possible.

One danger common to both radiation and surgery is that the underlying cause of thyrotoxicosis may remain untreated. In many cases neurosis bordering on psychosis has seemed to me to be the cause and should be treated.

#### The Effect of Differences in Technique

Several techniques have been used for X-ray treatment, but only one method for radium in this series.

The radium technique has been to apply radium on a wax collar at a distance of 4 cm. from the skin. The dose delivered at a depth of 2 cm. to the surface of the skin, treating an area of about 8 cm. square over each side of the thyroid, is of the order of 1,000 r in ten days. This course of treatment is repeated after about three months and again three months later in most cases. In some cases, fewer than three courses, and in some a fourth course of treatment, were used. For the treatment, the patients were admitted to hospital and the radium applied for twelve hours daily for ten days.

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The X-ray techniques can be divided into four groups:

A.—One dose of radiation of 400 r delivered to the whole of the thyroid, small fields being arranged to deliver the dose uniformly.

B.—A dose of about 800 r delivered to the thyroid gland in one week.

C.—A dose of about 1,200 r delivered to the thyroid gland in two weeks.

D.—Weekly doses of about 250 r given for about eight to ten weeks.

200 kV. 1 mm. Cu. H.V.L. 1.5 cm.

In all these methods, the size of the field used was sufficient only to cover the gland. No attempt was made to use large fields of about 15 or 20 cm. in diameter such as have been used by various American authors.

The effects of the various methods of treatment in bringing about cure or marked improvement have been analysed. This analysis indicates no effect of age on the time of improvement of the patients' symptoms and signs and these figures are not included.

The relationship of type of treatment to the time of improvement is indicated in the accompanying tables. Adequate data were not available at the time of this analysis, but no selection was attempted, the figures being taken from notes made at the time the improvement was noted.

#### PRIMARY THYROTOXICOSIS—Initial Improvement

Of 46 out of 50 patients in whom such notes were available, 25 showed improvement within one month of treatment being started and 39 within three months. The proportions for radium and X-rays of early initial improvement are similar.

# Final Improvement

The striking fact here is that nearly half the patients treated by X-rays were cured in less than three months, while the same proportion of patients treated by radium did not attain final improvement for one or two years and, similarly, those previously operated on showed late final improvement but early initial improvement. Most of these were treated by X-rays.

#### SECONDARY THYROTOXICOSIS—Initial Improvement

3 out of the 4 treated with X-rays showed initial improvement within one month, while only 3 out of 12 of the radium patients showed initial improvement in the first month. Of the 2 treated after operation, both show late initial improvement being treated with only one course of radium.

#### Final Improvement

The final improvement of the radium cases was again relatively late, but so was that of the cases treated with X-rays, although both of those previously operated on were cured within one year.

The early improvement of most of the cases makes radiotherapy in no way inferior to medical treatment and the long period of invalidism to which the latter condemns a patient is definitely avoided. The difference between the effects of radium and X-rays, however, suggests that the irradiation of the rest of the body may have a delaying effect on the ultimate result. When one remembers the generalized hyperplasia of lymphoid tissue which is characteristic of exophthalmic goitre these results suggest that this lymphoid tissue, sensitive as it is known to be to radiation, may be damaged by the radium and that its damage may result in a delay in the healing processes, whatever they are. The implication of this speculation is that the lymphoid reaction may be an attempt to deal with the cause or the effects of the toxic process.

This suggests that X-ray treatment is better than radium for thyrotoxicosis. There is an added advantage in X-ray treatment when one considers that the patients so treated were all treated as out-patients and did not require hospitalization. Moreover, although the radium cases all rested in bed during treatment two of them developed crises which were treated with intravenous saline and digitalis, and none of the X-ray patients were so affected.

The patients undergoing treatment are advised to rest, but are not kept in bed unless their general condition, or the treatment, make it necessary. The effect of radiation on the thyroid gland seems to be to cause involution. Three slides are shown in which radium was used before operation and one in which no radiation was used. The patients all had iodine, so that the difference cannot be said to be due to iodine.

In connexion with the question of iodine treatment as an adjuvant to radiotherapy I can only say that my impression, for which I have no proof, is that cases so treated at the time of radiation were longer in recovering from their thyrotoxic symptoms. This accords with the view of Jenkinson and Hunter (1938) and Williams (1932).

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No adverse effect on the operation was caused by the radiation. In no case were the operation difficulties increased by the previous radiation and no operation mortality has occurred.

In the past ten years many papers have been published in the continental and especially in the American literature and from these it is obvious that results of the kind I have been discussing have been obtained for some time. This being so it is difficult to understand why in this country more radiotherapy has not been practised in this condition. It may be due to a mistrust of results which I hope this analysis will do something to dispel. The criteria of improvement should certainly be very rigid to satisfy us, but these criteria should be applied equally to both surgical and radiological cases.

The possibilities of radiotherapy do not necessarily end with the thyroid. Cases have been reported in which the pituitary was irradiated (Borak, 1935; Habs, 1936), and it is suggested that combined irradiation of the pituitary and the thyroid might improve the results, the latter author noting a more rapid improvement in the combined cases.

In two cases of this series the pituitary was irradiated and in one temporary improvement was noted, no other treatment being given. In the other, the irradiation of the pituitary was followed by a rapid disappearance of the remainder of the thyrotoxic symptoms persisting after treatment by a radium collar.

#### Conclusions

In routine treatments the conclusion may be drawn that radiation with X-rays (or a radium beam) to the thyroid is the treatment of choice in primary thyrotoxicosis, but that in secondary thyrotoxicosis operation is the treatment of choice, because although X-rays may be used to improve such cases, it cannot cure the cardiac irregularity and the delay in improvement relative to operative results might allow cardiac degeneration to become worse.

My thanks are due for the help of all the medical and clerical workers of the Sheffield Radium Centre, and especially to Dr. Brody and Dr. Shanks, without whose help I could not have done the necessary work. I am grateful to Dr. Hermitte for the histological slides and to Mr. Watson for preparing the other slides.

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[The foregoing papers were amongst those read at this meeting.]

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# Section of Psychiatry

President-A. A. W. PETRIE, M.D., F.R.C.P.

[October 14, 1941]

# Reconstruction in Psychiatry (Abridged)

### PRESIDENT'S ADDRESS

By A. A. W. Petrie, M.D., F.R.C.P.

My predecessor in this Chair, Dr. C. P. Symonds, gave a reasoned statement in his Presidential Address why he believed that Neurology and Psychiatry would inevitably come together into one combined specialty, whose practitioners he designated as Neuro-Psychiatrists. I firmly believe in this, and in this paper I have reiterated such arguments.

The subject matter discussed has largely appeared in various documents such as the Feversham Report on the Voluntary Mental Health Services [1], the Report of the Committee on Mental Health Services, of the British Medical Association [2], and some of the points were considered in a departmental committee under the Earl of Radnor, the activities of which were terminated by the war. Various committees also considered medical education in relation to psychiatry and made reports. I have referred to voluntary sterilization which has been the subject of a blue book [3]. A brief combined re-statement of all these projected changes does not appear inopportune at the present time.

What will be the future of medical practice? Will the general practitioner and the consultant whose independence has been so valuable to the community become mere Civil Servants without proper power of expression and representation?

The future of Psychiatry is important both to the medical profession and to the community at large.

It is still a developing service made up of different components.

At present workers enter this field from a number of different aspects, with the result that their knowledge reflects their angle of incidence, and to this knowledge is generally added a number of prejudices which prevent a proper conception of the whole. I envisage a gradual merging of these components into one important and dominant group of medical opinion, influencing the profession and the nation.

The gap between the academic psychologist and the medical psychologist is to some extent bridged by the industrial and educational psychologist, to whom the subject of potential capacity means so much. The utilization of elementary psychological principles in advising suitable occupations has diminished the number of misfits and has resulted in increased output. Factory rules and regulations have been modified to the benefit of all concerned. Proneness to accident is another point on which the psychological worker may warn the industrialist, and so save trouble both to the employer and to the insurance company.

Closer contact between the psychiatrist and industry is necessary when considering the problem of absence from work, due to neurosis. These absences are described under many different headings, such as dyspepsia or bronchial asthma, according to which organ the patient primarily complains about. An understanding psychiatric physician would soon diagnose the essential condition and save many big industrial undertakings a large number of hours owing to absences.

The educational worker is undertaking most important work, and it has been suggested that the future university student can be predicted when at an elementary school. There is a danger of too great deductions being made from these tests. The emotional and volitional factors are not covered by the usual tests, and these factors are at least as important as the intellectual equipment, and although personality tests are being developed, these are apt to depend too much on the point of view of the investigator. Interviewing boards, to modify the results of a pure examination system, show the reaction against the errors which can be made by a slavish adherence to any mechanical form of test. The mistakes that a pure examination scheme can produce, is shown in the fallacies of an earlier civilization, namely, that of China where a too conventionalized examination system caused a stagnation which ultimately led to violent upheaval. A personal evaluating factor to counter-balance this can be supplied by the experienced physician. Recent personnel selection in the armed forces is developing on these lines. All psychiatrists come across the unstable, but highly intelligent person, who, exalted

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beyond his capacity, causes trouble and who generally fails to develop into a personality

capable of guiding others.

On the mental deficiency side, the training evolved, mainly from the educational side, has proved of great value. Careful and systematic teaching raises the whole standard of the individual, and in the higher grades, enables a practical system of resocialization to be attempted with some success. In the lower phases of mental deficiency there are many contacts with the neurologist and many syndromes have been described bearing on neurological work. Again, schizoid deterioration is not uncommon in the defective, indicating the need among such cases, for an individual with a knowledge of neuro-

pathology and general psychiatric experience allied to a knowledge of mental deficiency. The approach from the side of the neurosis has perhaps attracted the most interest as it involves the greatest number of potential patients, and touches general medicine at all its angles.

The psychology of many different physical diseases is attracting more attention and the need for teaching the medical student these aspects is slowly being appreciated. The present-day student is realizing that in a considerable proportion of his patients, the psychological factor is predominant, and its consideration is essential to a proper diagnosis and treatment of the cause.

These minor failures to adjust to the environment are receiving increasing notice, and opinion varies as to the relative importance of the constitutional and environmental factors. The former is stressed by those who tend to ignore the possibilities of treatment, while the latter is inclined to be over-emphasized by those who treat them. It is becoming apparent that organic upsets in the central nervous system can create or increase the tendency to the neurotic or the psychoneurotic reaction in those formerly normal or comparatively normal. The obvious instance is seen in the sequelæ of epidemic encephalitis, while the most evident analogous organic disorder in the psychoses is seen in general paralysis. In each case, the importance of an organic disturbance is apparent and it is here that the neuro-pathologist and neurologist can so suitably work in conjunction with a psychiatrist or better still, a neuro-psychiatrist.

## The Basis of the Mental Health Services

Useful work is being done by the National Council for Mental Hygiene which has linked the voluntary psychiatric activities together, and brings these needs before the public. The work of the Feversham Committee was to inquire as to these activities and to co-ordinate and focus them into an effective whole. These proposals suggested the fusion of the National Council for Mental Hygiene, the Central Association for Mental Welfare, and the Child Guidance Council, into one body to be called the National Council for Mental Health for England and Wales. The Feversham Committee presented an excellent report which assumes the voluntary principle where possible, and suggests the linking up of all activities, for example, the co-operation between the education and mental health committees of County Councils, with, in some cases, joint committees, is an obvious necessity. The report quotes Professor Henderson as saying that we must talk of mental health and its maintenance, rather than mental disease and its cure. This is an essential outlook. The physical and mental health services should be closely united and this has recently been done in London—a progressive step.

### MENTAL SERVICES AND PSYCHIATRIC HOSPITALS

A radical change of standpoint among public bodies is essential, and a well-coordinated scheme between the voluntary and State or municipal services is as important from the mental aspect as on the physical health side.

The public bodies should establish or reconstitute mental health committees, which will deal with all questions relating to mental health, in their area. Their function will be to further mental health, and only incidentally to deal with segregation.

The educational problem, including child guidance, as well as that for the various grades of mental deficiency, will need to be included in these schemes, and representatives should be appointed to confer and co-ordinate with the clinics held at voluntary hospitals and elsewhere.

The Joint Board should be formed of university or hospital authorities and the local

Should beds for mental cases be in a general hospital or in an associated clinic? The absence of facilities for exercise and adequate occupations, which is essentially a part of mental treatment, renders any small unit, without such amenities inadequate and structural modifications, if acute cases are taken, make such a unit difficult to obtain. Against this is the need felt in all large hospitals for some beds where cases taken from the other departments, e.g. maternity or medical, can come for mental observation. This

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would save cases having their physical progress interrupted by being removed to quite another institution.

A larger clinic serving a group of hospitals is able to provide more beds, and allows a better classification, and, given a suitable location, may have space to allow proper

exercise and occupational centres.

The obvious rejoinder is to move it to the country, or to set up its functions in the grounds of the mental hospital. Under present conditions, I believe such a unit is best maintained in juxtaposition to a general hospital, where every form of expert advice is readily obtainable. Given that the planning of the future transfers the great hospitals to the periphery of the cities, part of this objection would be met and the mental unit could move with the general hospital. There are two sources from which such units can develop: a centre for less acute cases receiving the psychoneurotics and mild psychoses on a voluntary basis, and a unit receiving the more acute psychoses, including those who need care and restraint. If the clinic for milder types is evolved as part of a general hospital, no further co-ordination will be necessary, but if it develops as a separate unit, its out-patient department both for children and adults, will need to be linked up with those of the neighbouring teaching hospital, and its facilities made available for students. Similarly, with in-patients, there will be no need to duplicate beds, if the unit is close to the teaching hospital.

As indicated, one source of development of such a clinic is as part of the university or teaching hospital; so far this has not occurred in this country, although there have been tentative attempts to establish such centres in connexion with teaching hospitals in London and the Midlands, but the war has stultified such efforts. Generally speaking, however, it is likely that the university clinics will tend to be devoted to the less acute kind of mental illness. The type of case received will inevitably largely depend on the director of the clinic, as he naturally attracts the type of case in which he is interested. One with a practice primarily concerned with the neuroses will receive many of this class and incipient psychoses may prevail more in other instances. Perhaps the most interesting and important from the point of view of development is the neuropsychiatric clinic, which may be a special ward or branch of a more general unit. Under Sir Frederick Mott, the Maudsley Hospital, when dealing with military cases during the 1914-18 war, combined all these functions with reasonable success, and under Professor Winkel the Utrecht clinic had a similar tendency. The Tavistock Clinic has also concentrated its activities on out-patient work with the psychoneuroses, and has combined teaching with its other activities.

The only really notable development of the clinic idea in England, has been the Maudsley Hospital, which represents a University Clinic maintained by a municipal authority. This was initiated, when a sum of money was left by that far-sighted benefactor, Henry Carr Maudsley, aided by Sir Frederick Mott, and their ideals were further developed by Edward Mapother. Despite the notable success attained, no municipality has so far attempted to repeat the venture.

Coming to the unit for the more acute type of case I believe the study of the early stages of the more acute syndromes offers an even greater scope for physiological and neuropsychiatric investigations. Every kind of clinical and metabolic observation at this stage is likely to be of value, but at present, little use is made of these facilities. In the larger cities these cases are generally received into observation wards, but the buildings and laboratory facilities are often ill-adapted for their purpose; the staff maintained is not necessarily expert and sometimes nurses, attendants, and doctors regard the work as troublesome and uninteresting.

No attempt has so far been made to change the observation ward into a psychiatric hospital for the more acute type, although the London observation wards have been combined, enlarged and improved. The utilization of such reception centres as teaching research units, has been little developed. The first steps, already taken in London, are to provide specially trained doctors and nurses, and this alteration alone has produced greatly improved conditions. After this, a removal to more suitable buildings should be merely a question of time.

Improvements in the observation wards may gradually transform them into psychiatric hospitals where real advancement in the specialty can be made. Then perhaps as the worth of this work is realized, enlightened municipalities will create suitable buildings.

In the smaller towns, the possibility of two psychiatric hospitals in one area hardly seems reasonable, and a fusion of all psychiatric clinics in one centre seems the only solution. Here again, the question as to the basis arises. Will developments come from the side of the key general hospital or will the municipal services gradually improve until the broader psychiatric needs of the neighbourhood are satisfied?

#### Mental Hospitals

No number of clinics will remove the need for treatment in the mental hospitals, owing to the fact that many cases take longer to recover than can be reasonably catered for in a clinic, with its limited number of beds. Further, it is impossible to forecast with certainty which cases will ultimately recover, and which may need continued care. Many potentially recoverable cases will be sent to the mental hospitals.

No one can deny that there is apprehension and a sense of inferiority at the suggestion of care at a mental hospital. The patient is considered to have disgraced himself, and reflexly, his relatives, by exhibiting abnormality. This is partly due to the mediæval attitude still felt towards any mental disturbance, where disorder of conduct is exhibited, and is based partly on the sound principle that stable stocks do not exhibit mental disorder, and that there must therefore be some weakness, degeneration or deteriorating of the stock, for such an abnormality to appear. Many of those who express an unnatural antipathy towards psychiatry and psychiatrists are sometimes exhibiting an over-reaction to a fear or knowledge of such instability in their own family group. Allowing for all these factors, a third reason, for prejudice against mental hospitals, remains the fact that segregation of the chronic patient is dealt with in the same institution as the treatment of the recoverable.

So far, the Board of Control has met the problem by inducing all authorities to build in the grounds of the mental hospital, admission units for recoverable cases, separated from the chronic wards, by means of separate entrances and similar devices and have thus endeavoured to dispel the prejudice. I believe that if recoverable units were situated on land separated from the mental hospital much prejudice would be avoided.

Buildings on nearby sites will cost little more than siting such buildings within the grounds of the mental hospital. The staffing of such units from the mental hospital will obviate much of the cost of establishing a new unit complete with personnel. This gives the further advantage that it will keep the medical men and nurses of the mental hospital in contact with the recent and recoverable cases which is so essential. Any type of staff, either medical or nursing, tends to deteriorate if only brought into contact with chronic patients. It must be admitted that the main mental hospital will become more depressing if recoveries and discharges are rare events, but the benefit to the recoverable patients, in treating them apart, seems to justify the experiment.

In public bodies who control many institutions, the question of the separate accommodation for the recoverable patients might, it is argued, be solved by the use of one hospital for all recoverable cases; against this is the problem of the medical and nursing staffs and also the fact that patients need to be treated somewhere near their own districts. Further, any unit of acute cases must be strictly limited in numbers, to allow of intensive care and supervision.

The social services include reports on admissions, with adjustments in their homes, help to those undergoing care, and resocialization of those fit for discharge. The object of every well-organized mental service should be to prevent or diminish the large and costly segregation problem. Some persons will need care for many years, but many, although not recovered, may be resocialized in from one year to eighteen months, while others gradually lose their acute symptoms often with an increasing degree of deterioration and dementia. Resocialization and partial resocialization should be tried, particularly among the older age-groups, by a systematic boarding-out, or prolonged trial system. Cases of doubtful stability which, if discharged forthwith, or after a short trial period, will inevitably relapse may be resocialized if dealt with slowly. Remunerative work where they may be economically self-supporting should be found. To a slight extent, this development touches the need for sterilization, but among the older age-groups, this will hardly be

The Mental After Care Association provides after care homes, but all large services should obviously have rehabilitation centres of their own, where discharges can be received, and suitable employment found for them and a home to live in.

If every quiescent patient was systematically dealt with on these lines, before he or she became institutionalized, a vast saving to the community would result. One trouble in trying to discharge such patients, who have been in for a period of time, is that they have become too lazy to face the struggle for existence. Unless urged by the desire for sexual gratification or alcoholic refreshment, they have no motive to re-face a world which has usually treated them badly.

The aggregation of these groups of institutionalized patients has been defended on the ground that by their work they help run the institution, and enable the others to be maintained at a cheaper rate. The patient whose work equals his cost of maintenance is rare, and in nearly all cases, the debit is definitely against the patient.

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In such reconstituted mental health services an experienced adviser is essential. It is rare, however, to find in any one individual a knowledge of the neuroses, psychoses and mental deficiency and also of educational problems.

In the large areas, such services can be organized within present boundaries but unless the smaller areas are enlarged or co-operate together, proper services on these lines will not be possible.

London, Yorkshire and Lancashire, each form large grouped areas, where it should be easy to provide all mental facilities. In more sparsely populated districts, greater difficulties will arise. It is, however, possible to plan a regionialized system for England and Wales which would divide up the country into sections, each forming its own mental health group, complete with research and clinical centre, reception unit, social service and rehabilitation centre, not too far removed from local sub-sections, so as to enable the area to function progressively, as regards its mental health.

The cost of a well-organized mental health service will be repaid by diminishing the segregation problem, and by improving the mental and general health of the community. The outlay of psychiatric hospitals by the provision of early and suitable care, will be worth while, as cases will more readily come forward before the terminal stages, when treatment is of little avail.

The placing of the more recoverable types into buildings separated from the mental hospitals will give the recoverable mental patient a sense of being treated entirely under hospital conditions, and this, I believe, will alter the whole attitude, and dissolve much of the prejudice towards mental illness. It is only a step forward from the practice already followed in mental hospitals of keeping recoverable cases in admission units until discharge, or chronicity, supervenes.

Against this, it will be said that observation units are not necessary, and that the direct admission into the mental hospital is the obvious procedure. It is argued that by doing this, the whole status of the segregated chronic section can be sustained at a hospital level, whereas this actually prevents a true therapeutic attitude being taken towards the recoverable case. "Asylums" have been relabelled "Mental Hospitals" and now "Hospitals" but the same prejudice still largely persists. Why not change all this by altering the basis and completely separating treatment from segregation?

[Section on problems of prevention and treatment and a discussion on causation are omitted owing to paper shortage.]

# Eugenic Factors

In mental disorder we are still seeking causes, while treatment especially among the functional psychoses is, despite some advances, unsatisfactory and largely empirical. One cause is heredity, but even here we have not reached a satisfactory basis, although investigations are slowly pointing a way. The two syndromes in which the heredity factor seems of greater importance are the manic-depressive group, and the schizophrenic and paranoid psychoses, and it is these that form the bulk of the cases of actual psychoses, with which we have to deal. If we are dealing with a simple Mendelian dominant, as in Huntington's chorea, the answer would be simple, namely, that it would be the duty of the State to stamp out the disorder by compulsory sterilization.

Unfortunately, these syndromes have not even simple recessive inheritance, although all figures indicate a definite and in some cases, a considerably higher proportion of abnormal inheritance, among those mentally disordered than among the normal population. The Brock Report states that inheritance is the commonest single cause of mental disorder, at the same time emphasizing the part played by environmental factors. In their recommendations, they suggest that, subject to the safeguards proposed, voluntary sterilization should be legalized in the case of (a) a person who is mentally defective, or who has suffered from mental disorder; (b) a person who suffers from or is believed to be a carrier of a grave physical disability, which has been shown to be transmissible; (c) a person who is believed to be likely to transmit mental disorder or defect.

This was presented in 1933, but the facts contained in it, although hotly debated, are incontrovertible, and society and the state are neglecting a primary duty to the health of the nation in shelving this obvious reform.

The fact that sterilization will only partly affect the problem, and that the disease may not manifest itself until after children have been born, and that the detection of latent carriers is difficult, should not deter from action. In a democracy, and until further knowledge is acquired, the first step must be on a voluntary basis, but even this should do something to prevent the spread of disease and degeneration among the healthy stocks.

Some allowance will have to be made for the fact that brilliant strains are sometimes

unstable, although strong counter considerations would be necessary to justify failing to maintain the health of the nation.

I was once told by an abnormal member of an artistic family that seven of his brothers and sisters were abnormal while two were geniuses. Two were certainly prominent figures in one of the great arts, and presumably the rest were liabilities to their family and the nation.

Where abnormals, generally of the neurotic type, realize their limitations, and are willing to undergo voluntary sterilization, it seems a tragedy to withhold this. Such people wish to preserve those following them from the subjective misery they themselves have suffered, and when one considers the sum total of misery caused to others, surely we should cease to hesitate.

The intricate problem of sterilization of the mentally defective also awaits attention. Conversely, great blame attaches to the higher elements of population who voluntarily sterilize or partially sterilize themselves by having one or two, or at the most three children, alleging economic necessity. Taxation designed to counter this tendency is the obvious remedy.

Something more than mere replacement is needed by the higher types, and every form of pressure, social and economic, should be directed towards the production of large families.

The recent tendency to a release of the ban on marriage among women employees in public services, shows a belated recognition of the fact that artificially induced spinsterhood among competent citizens is against national interest.

### TRAINING OF THE MEDICAL STUDENT

Efforts to increase the psychological knowledge of the medical student have largely been resisted, on the grounds that the curriculum is already more than overloaded. Psychology is best taught with physiology but if this cannot be arranged owing to the overloaded curriculum it might be studied with the preliminary sciences and some knowledge might even be taught at the school level, among the much wider range of subjects now permitted to qualify for the entrance to the universities.

The student should be taught systematically to study the psychological make-up of every patient that he sees. Sometimes this will enable him to diagnose the condition in question. In many cases it will aid in the treatment of the patient, and even at times when it may appear irrelevant, it will have helped him towards a knowledge of mankind in general, so essential to any form of medical practice. If every clerk and dresser were compelled to add a paragraph in their case-taking, regarding the psychology of their patients, much benefit would result both to the patients and students.

Apart from general medical and surgical cases, there are numerous ear, nose, throat and gynæcological cases and other special departments' cases where an adjustment of the psychological condition is as important as treating the immediate symptoms for which the patient seeks relief.

A generation trained on these lines will be greatly helped in their approach to their patients, and it will be advantageous to every kind of specialist and prove of inestimable value to those in general practice.

Apart from this necessary training in sizing up the general mentality of the patient, the practitioner needs to know and understand the possible neurotic reactions of his patients, and this can be acquired in all departments apart from that specializing in psychological medicine. The anxiety states and their variations are of principal importance, but hysterical manifestations, especially those associated with somatic disease are also important

For the rest much can be done by teaching the students at the observation ward or at psychiatric hospitals, developed from these wards. These are usually, in the great cities, quite close to the teaching hospitals and medical schools. Little time will thus be wasted in travelling to and fro. Here he will meet the type of case which needs quick decisions in practice and which may recover so rapidly, that more permanent care may be avoided.

Demonstrations on mental deficiency are, of course, given to students, enabling them to recognize types, and to judge what can be done in any particular case, such as the use of Child Guidance Clinics. Parents bringing children to doctors always hope for a more favourable verdict than the one which they have previously received, but are unwilling to accept as true.

A knowledge of the value of intelligence testing is now becoming more universal, but the recent developments of the Educational Services is still not appreciated by all practitioners.

The general control of all this training is probably best in the hands of one supervising instructor.

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At most hospitals it is customary to allocate clerks to the Psychological Out-patients Department, where a conception of the neuroses, and, to some extent, the incipient psychoses, is obtained. To demonstrate psychotherapy in front of students is difficult, as patients are more ready to display their bodies in front of others than the intimacies of their minds, but after the patient has explained his symptoms, it is then easy in his absence for the teacher to expound the underlying basis of any case which he has previously investigated. This teaching can be linked up with tuition on suitable ward cases presenting psychological symptoms.

The psychology of the child and its mother is of great importance to the student, and co-operation between the psychological department and the pediatrician is essential. Some organized assistance for dealing with children is necessary, and it is questionable how far such units should be in touch with the general hospital, or form special units such as Child Guidance Centres. In any case, some study of the mental development and behaviour of the normal child is an essential of medical education.

The demonstrations at special centres are probably best given by teachers who are expert at those centres, as they will be more familiar with the cases, always assuming that reasonably expert tuition is available. Such supplementary teachers could be appointed clinical psychiatrists, and could give the teaching at the observation wards, and at the mental hospitals and mental deficiency institutions. An extension of the resident clinical clerkships among senior students would often attract suitable recruits to this class of work. It may be objected that this programme will greatly enlarge the time given by the medical student to the study of psychological medicine, leading, for example, to the reglect of medicine and surgery. Actually, little more time would be needed, and the bulk of the suggestions as to supplementing the physical side by the study of the psychological aspects, is what all good physicians have done throughout the ages, whether it be called a good bedside manner or given a higher sounding name.

As a corollary to the training of the medical student the teaching of the student nurse needs similar guidance, and some elementary lectures in psychology would be of great help in developing their training on proper lines. A system of seconding general trained nurses for short periods, to various mental treatment centres, would greatly help in promoting the understanding of both the neurotic and psychotic cases. In particular, it would increase the supply of nurses for dealing with the milder type of case cared for at home.

#### TRAINING OF THE SPECIALIST

All those connected with the present diploma in psychological medicine are striving to raise the training, and standard of examination, and it can, generally speaking, be said that the quality of the candidates is rather holding back the endeavour. Most of these come from the mental institutions and require to obtain the diploma if any advancement is to be obtained.

At present the principal diplomas demand, in the first part, a knowledge of anatomy and physiology of the nervous system and psychology together with some practical knowledge of the neuro-histological methods and also of practical psychology. In the second part, apart from the papers, a clinical examination is demanded both in neurology and psychiatry, the latter including the neuroses, psychoses and mental deficiency. In the London area most candidates acquire much of their knowledge from courses conducted at the Maudsley Hospital, or at times at Bethlem Hospital. Few candidates have come up to these courses with experience of more than one type of institution.

The requirements of the examining boards are likely in the future to demand experience in the neuroses, the psychoses and mental deficiency, and child psychiatry. Apart from properly devised courses, it is difficult for candidates to obtain such knowledge.

Such are the present difficulties, and these are often reflected in the one-sided knowledge of the candidates. If it were possible to insist on a really high standard, the diploma would largely fulfil any specialist requirements. The existing diploma is not, however, attracting the prospective neurologist, or the psychotherapist, who feels his especial needs are not catered for.

Dealing first with the neuro-psychiatrist, he will be required to exhibit expert knowledge of organic neurology, and be expected to be able to investigate problems in neuro-psychiatry. If he is to be able to do this, he will require a high standard in neuro-pathology, unlikely to be acquired by less than six months' work in a research laboratory. He will also need to become familiar with all methods of investigation, and he will require to have a good acquaintanceship with the biochemical problems likely to affect his work.

Research scholarships should assist in obtaining these workers, and it is in their training that our future hopes lie. What is to be the future of such workers?

A few will become teaching neurologists with a more tolerant bias, and perhaps a greater knowledge of the psychiatric work which they are so often called upon to deal with in private practice. Some will become teaching and consulting psychiatrists, and it is to be hoped that in the future, both these groups will become neuro-psychiatrists. It is also to be hoped that a number of these will find their métier in investigation and become directors of neuro-psychiatric laboratories, with which every properly organized mental health service should be associated. The type of worker outlined will, of course, easily obtain the ordinary higher diplomas of M.D. and M.R.C.P. and presumably that of the diploma in psychological medicine. Perhaps granting a diploma with special knowledge in neuro-pathology might meet these requirements, rather than giving a special diploma in neuro-psychiatry.

A conceivable solution would be to start a college in neuro-psychiatry, with Fellows and Members, as with obstetricians and gynæcologists, although this is hardly a solution which commends itself. At one time the Royal College of Physicians allowed its members to pass an examination indicating their special competence in psychological medicine, and some revival and modification of this might meet the requirements for a higher diploma for specialists.

The question of an added qualification for the medical psychotherapist raises even more debatable issues, but even a diploma in psychological medicine with special knowledge of psychotherapy seems hardly feasible.

There are a number of different schools of psychotherapy, all tending to be mutually exclusive, and an attempt to devise a test of competence is likely to daunt the boldest. While everyone has absorbed the salient and most important ideas put forward by the leading schools of psychotherapeutic thought, there is considerable divergence of view, and standpoint, and those closely attracted to certain schools of thought have evolved minor divergences of their own. Apart from the aspect of neuro-psychiatry, there have been demands for special diplomas in mental deficiency, in psychotherapy and child guidance, and delinquency may also follow suit. Such a spate of diplomas is not, in my opinion, feasible, and the institution of psychotherapeutic diplomas would have the added danger that non-medical psychologists of academic standing may wish to obtain it.

Allied to this last question is that of spiritual guidance. There are signs that the church, which at one time was largely concerned with healing may wish to re-undertake a portion of this section of our work. The wiser councils on both sides would limit the work of the doctor to the person suffering from symptoms which can be described as disease, while the work of the priest would be limited to the disturbed but normal person. This, it can be understood, is a very fine line of distinction, in which overlapping can When patients require in-patient treatment, it seems likely that the province of the doctor is involved, and even out-patient treatment, requiring regular seances associated with payment seems to come within the same category. Much though the medical psychologist might wish to guide the thought of the nation, and wisely though he would doubtless perform this function, he has to remember that other advisers exist whose standpoint may not always be the same as his own. The problem of assisting by giving suitable psychological instruction to the younger members of religious bodies is obviously the proper way in which co-operation should be given, and the effect of such teaching, judiciously given, should be to harmonize points of view and lessen mental stress and unnecessary repressions.

#### SUMMARY

I recommend the creation of mental health services throughout the country, embracing areas large enough to provide every facility, with the separation of all potentially recoverable mental patients from those who have become chronic. An effort should be made to reduce the segregation problem by attempting the resocialization of all possible mental and mentally defective persons, with safeguards against the spread of the disease or defect by procreation.

As a preliminary measure, I suggest the voluntary sterilization of all markedly neurotic or psychotic patients who desire this, in the belief that much unhappiness will be prevented thereby, both among the unstable and those who have to associate with them.

There should be improved facilities in the psychological education of the medical student and a fusion of the varied interests in psychiatry, so that all the elements might benefit by a comparatively common training, thus forming an important body of opinion, which would direct and guide the mental health of the whole country.

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# Section of Epidemiology and State Medicine

President-E. H. R. HARRIES, M.D.

[April 24, 1942]

### DISCUSSION ON THE FUTURE OF PUBLIC HEALTH NURSING

Miss M. E. Flambert (Deputy Chief Nursing Officer, Ministry of Health): To-day we find that most of our health visitors have qualified for this work by taking a three or four years' training in general nursing followed by six months' or a year's training in midwifery, as well as the health visitor's course; a total period of from four and a half to

five and a half years.

I am purposely touching on the training of health visitors because, although it is generally agreed that the best basis for their future work is that of a general trained nurse, there is some doubt whether the general training, as it is to-day, is sufficiently comprehensive. In the many schemes for the revision of the general training which have been put forward, emphasis has been laid on the importance of including more preventive teaching in the early stages of hospital training, as well as more practical experience in the nursing of infectious diseases, mental patients and the home nursing of the sick. In fact there seems to be a universal acceptance of the view that nurses should be prepared to do preventive as well as curative work and that the basic training should include the fundamentals of public health nursing.

I suppose the nearest approach to a comprehensive form of service is being undertaken to-day by those Queen's nurses who are doing health visiting as well as district nursing and midwifery. These nurses are, for the most part, working in rural or semi-rural areas where it has become obvious that much time will be saved if one person can undertake

all forms of nursing work, curative as well as preventive.

Many statutory duties dealing with maternity and child welfare and tuberculosis work are, in County areas, delegated to County and District Nursing Associations. These Associations are dependent to a large extent on voluntary contributions with the result that many rural areas are unable to afford the services of a fully qualified district nurse. Instead they train what are known as village nurse-midwives—girls who have been given a full midwifery training plus six months' experience in district nursing and perhaps three months' health work. These nurse-midwives undertake in most instances midwifery and district nursing and sometimes health visiting.

Dr. James Fenton in his Presidential Address to the Society of Medical Officers of Health in 1937 (M. Officer, 58, 99) said: "Nursing, in the broad interpretation of the word, is to-day a community service as is the profession of medicine and the two must supply what is required by modern enlightened opinion. This is a threefold requirement: The curing of disease; (2) the prevention of disease; (3) the teaching of health to the healthy." I should like to see all public health nurses prepared in this way so that the district nurse, whose district may be so populous that she cannot undertake the work of a health visitor, will also waste no opportunity of impressing on her patients the value of maintaining health and preventing disease.

The opportunities for public health nursing should be much more widely advertised, by talks to girls of school leaving age, and to parents and teachers, so that girls who are interested in social work and education may be attracted at an early age to public health nursing. At present, the girl who enters hospital has her vision of the future coloured by the prospect of caring for the sick for the rest of her days and may know nothing of

the other and wider fields of nursing work.

A longer qualifying period required of student health visitors has also been recommended; that is to say that the health visitor's certificate should not be awarded until the student has been given a longer period of training and an opportunity of demonstrating her suitability for the work, as well as her ability to teach. This will of course not be possible unless more financial assistance is forthcoming, either in the form of grants or bursaries.

The present training syllabus for health visitors is constantly under review. extensive alteration must wait for the revision of the basic training, as it may then be possible to include instruction in psychology and methods of teaching, in addition to a wider study of economic and social conditions. Social life in all its varying phases

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and states is of course the background of a health visitor's work; she must have a thorough understanding of social problems, and of the numerous social services, both voluntary and official. There is a tremendous lot of work being done by unseen, unheard and often unpaid social workers in this country and I should like to see it recognized as playing an important part in our health services.

School nursing.—There are many trained nurses employed in school nursing work only, but in an increasing number of cases outside London the work of the health visitor and school nurse is being combined, so as to give continuity of supervision of a child's life from birth to 14 years of age. To-day a school nurse must be general trained and state registered but she is not required to be a qualified midwife or health visitor. This means that her status is often not so high as that of a health visitor. No one will deny the importance of the work done by these school nurses and that they have great opportunities for health education.

I should like to see all health teaching in schools done by expert public health nurses who have demonstrated their ability to teach and have been specially selected and trained for this work.

If a better type of girl is to be attracted to public health nursing, one way of doing this would be to create more posts for superintendents of public health nurses, and even assistant superintendents, and to have such posts filled by experienced public health nurses who are capable of undertaking health teaching in schools, and elsewhere, while at the same time keeping in touch with practical health work.

Midwives.—As a profession almost distinct from nursing, midwifery is marching ahead and with improved salaries and better conditions we can look forward to a service which has no equal the world over. If we are to attract a sufficient number of nurses to midwifery, their chances of promotion must be greater and one way of doing this would be to increase the number of posts for non-medical supervisors. Besides improving the promotional prospects of the profession such appointments would also provide a supervision which would be both acceptable and profitable to the midwives themselves. Many health visitors and midwives would like to see the combined posts for supervisors of midwives and superintendent health visitors abolished. These are certainly two very distinct branches of nursing work and it is possible that many excellent women may be excluded because they have not had the necessary experience in either one branch or the other.

Nurses in industry.—Industrial nursing is only in its infancy but there seems to be an increasing awareness on the part of factory inspectors, and managers, of the value of this work, as evidenced by the rapid rise in the number of nurses both trained and untrained who have taken posts in factories since the outbreak of war. The Factory Act of 1937 mentioned medical supervision for the first time and as the law stands to-day the person in charge of an ambulance room in a factory is required to be "A qualified nurse or other person trained in first aid". Unfortunately this provides a loop-hole in that these posts can be filled by lay men or women who have the necessary first-aid qualifications for dealing with minor injuries yet do not possess the wider knowledge of health and disease which so befits the trained nurse for this work.

Miss E. Cogswell Phillips, B.S., M.A., R.N. (Associate Chief Nurse, in charge of Public Health Nursing American Red Cross—Harvard Field Hospital Unit): American public health nursing dates back only about forty years. The formation of the National Organization for Public Health Nursing in 1912 was a great step forward, for the aim of its members has always been to influence and improve the actual performance of public health nursing services—those services which are increasingly considered to be essential to the further development of the public health movement as a whole.

At the beginning of the present century there were only 130 public health nurses in the United States employed by only 58 agencies. By 1920 the number had increased to 9,000 in more than 4,000 agencies. The last twenty years have seen an increase to nearly 24,000 nurses working in over 6,000 organizations. These increases are encouraging but the development has always been most uneven in the various sections of the country. Furthermore, the standard of one public health nurse to 2,000 population, as set forth by the American Public Health Association, would require 65,000 public health nurses, three times the number we now have. To date this standard has been approached by only one state, Connecticut, while in another state, Oklahoma, the ratio is only one public health nurse per 16,500 population. At the present time our federal government is attempting by means of publicity and subsidies to the states, to add 10,000 new public health nurses to the field next year.

"Study of Nursing and Nursing Education in the United States", commonly known as the Rockefeller or Goldmark Report published in 1923, had a great influence upon the basic preparation of the public health nurse since her fundamental education is exactly

the same as that of the nurse in any other field of activity. To-day the basic courses in our better schools of nursing comprise experience in medical, surgical, obstetric, gynecologic, psychiatric, and pædiatric nursing, including the care of children with orthopædic and cardiac conditions as well as the care of the well child through experience in nursery schools whenever possible. An attempt is made too, to develop in the student a deep appreciation of the social and health aspects of nursing, both physical and mental, through an integrated programme of study in the classroom, wards, and out-patient department. It is upon such a foundation that the specialization of public health nursing is built after the nurse leaves the hospital.

"The Report on Municipal Health Practice in Eighty-Three Cities", known as the Winslow Report published in 1924, had a direct influence on the standards of preparation of the public health nurse, since it began to define her functions and outline her part in

public health programmes.

The lack of hospital facilities in many sections of our country, particularly in rural districts, makes it imperative that sufficient public health nurses be available everywhere, and that they give bedside nursing care in addition to assisting in the control of communicable disease and in health education. In total war this need is even more important. Because there were still many hundred localities that had no such service last year, the Emergency Health and Sanitation Act of 1941 provided for the appointment of public health nurses by the United States Public Health Service. These nurses are assigned to State departments of health, which in turn reassign them to local areas. By January 1942 over 500 nurses had been requested but only 151 had been appointed.

In July 1941 Congress appropriated \$1,250,000 (approximately £312,000) for the expansion of the number of all types of nursing personnel, and present indications are that for the fiscal year beginning next July, the amount will be \$2,000,000 (or about £500,000). About three-quarters of this fund is being devoted to the expansion of the basic undergraduate courses for all nurses, and the rest is being used for post-graduate preparation for the nursing specialties, of which public health nursing is one. A typical plan for

the training of public health nurses is as follows:

Graduates of approved schools of nursing who qualify for admission to a university course are eligible. They must have had no previous preparation or experience in public health. Four months, or one university term, is spent in a combined programme of college and field work which covers the first stage of the regular preparation of the public health nurse. The lectures are held in the university, and field work is done under the direction of a well-supervised public health nursing organization. An allowance of \$450 (or about £112) to cover tuition and subsistence is made. In return for this the nurse agrees to serve for at least two years as a junior public health nurse in any agency in the country specified by the United States Public Health Service. She also promises to complete within the next five years at least a year of university study in public health nursing. All courses satisfactorily completed, including field work, carry university credit and are counted toward the major requirements for a degree in science.

In the United States there are four kinds of organizations under which the public health nurse works: the official or tax-supported health agencies, the non-official or voluntary agencies, boards of education and commercial companies, both industrial and insurance. All four types are found in most districts although the official organizations play a more universal role. Because of our governmental organizations there can never be a federal programme applicable to the country as a whole. Each state now has its department of health but the core of the public health system will probably always be the smaller local units, the towns and counties, or a combination of them. On January 1, 1941, approximately only 4% of the 23,533 public health nurses were employed in state agencies, while 41% were in local rural or urban health departments. Non-official local agencies employed 25% of the total, while boards of education and industrial companies each had about 15%. The most rapid recent expansion in the employment of public health nurses has been in the factories, the number having increased by well over one-third in the past five years.

An all-over community health plan necessitates joint planning by all the agencies concerned. The tax-supported agency with its health officer will be the leader, but the voluntary organization must participate in the planning as well as in the execution of the programme. Nor must we stop with the public health agencies; the hospitals and other social organizations must join in. It has been demonstrated repeatedly that through a combination of agencies a higher standard for all public health services can be assured, and that

the cost to the community will be less.

Such a plan for the effective combination of organizations usually accepts the standard of not more than two health agencies administering public health nursing in an area, one under official auspices and the other privately financed and administered. This

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division of responsibility recognizes the traditional limitations on the use of public money and leaves the private agency free to undertake new services that will round out the community programme and to train personnel in ways that the official agency may not be able to do.

Until recently it was customary for public health nurses, whether in the employ of official or voluntary organizations, to be attached to specialized health programmes, and it was not unusual for a single family to have the services of several. This system was wasteful of time, money and energy of both family and community, but even after the recognition of this fact it was continued because we felt that one nurse could not be a specialist in all phases of public health. Now, however, we see that the proper place for the specialist in child hygiene, communicable disease, nutrition, tuberculosis, cancer and so forth is on the consultant or supervisory level, and that if the staff nurse has the benefit of their direction and experience she can give safer and more than adequate nursing care to the whole family. We are now beginning to treat the family as a real social unit for health work and find it is most successful from all points of view.

Our public health nurse works only under the direction of a physician. He may be the private doctor of the patient or he may be in the employ of the official health department, the hospital, school or factory, but he alone can be responsible for the care of the patient.

Public health nursing has been defined as "an organized service (not for profit) rendered by graduate nurses to the individual, the family and the community". Such a service includes the interpretation and the application of medical, nursing, sanitary and social procedures for the prevention of disease and the promotion of health. Often it involves the bedside care of the ill in their own homes. Primarily the public health nurse is an educator and this function of teaching underlies all of her activities in every phase of public health work in the home, the clinic, the factory and the school. Even when she is engaged in helping to evaluate a part of the public health programme which is directed towards a particular end, such as diphtheria immunization, or when she is working with physicians in the investigation of some public health problem involving a special situation, such as an epidemic, this teaching function remains of paramount importance.

In America the advanced preparation for public health nursing has always been through universities, but the National Organization for Public Health Nursing accredits such programmes of study. At the present time there are twenty-eight which meet with its approval. Many private scholarships, fellowships and loan funds have been set up during the past fifteen years to help nurses pay for their university education, and in addition in 1935, and again in 1941, federal funds were made available for this purpose. Employing agencies have been most generous in allowing members of their staffs leaves of absence to pursue full-time study. By January 1941 62% of all the supervising nurses in the country had completed one or more years of public health education, and over one-third of them held university degrees. The percentage among the staff nurses was not as high, only 21% having completed one or more years of advanced specialized study, and 19% possessing degrees. However, an additional 37% of them, and 26% of the supervisory group, were in the process of completing a year's study, so that the next time the data are compiled there should be a decided advancement.

Probably never has a profession developed more quickly than public health nursing. Many aspects of it are still in a state of flux, yet certain definite trends in its procedure and thought are emerging.

(1) Bedside nursing is becoming a part of many programmes where it has never been before. (2) The public health nurse now accompanies her verbal teaching by a great deal of practical demonstration, no longer does she "just talk". (3) The family is being regarded as a unit for health care and instruction, and the nurse who visits it does so in a generalized capacity, although her organization makes provision for her to have the advice and direction of many specialists. (4) The nurse in the school is working more with teachers than directly with children in order that a concept of healthful living may permeate throughout the entire school curriculum. (5) Those years of life which in the past have received far too little attention from health workers—the preschool period, adolescence and senescence—are being included in public health nursing programmes. (6) The care of the chronically ill, both adults and children, is being augmented and improved. (7) Emphasis is being placed on those aspects of the public health problem which involve a great degree of nursing skill, such as in the care of the premature, the child with cardiac disease and the patient with pneumonia. (8) Industry is utilizing the service of the public health nurse, not only in the factory but in the homes of its employees to care for their families as well.

To my mind even more encouraging signs are seen in the interest and help that the

leaders of public health nursing are giving in the recruitment of the right kind of girls to be students in our schools of nursing, and in the provision of richer undergraduate and post-graduate experiences.

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Miss I. Hawkins (New Zealand): As I have been away from New Zealand for five years I can only give you a few scattered pictures of public health life rather than details of

training and development of the Service,

New Zealand is a very new country. We started with all your experience behind us. There could be few problems for us that you had not already faced and dealt with, and put on record in the history of nursing, and this springboard, together with the friendly co-operation and help given to us by almost every country in the world, and particularly by our mother country, has made our task a good deal easier.

In all New Zealand there are only about 3,000,000 people, which means that we have no real slums. There are the poorer areas attached to all big cities, and we have the ever-growing potential slums to fight against; but we did not start our conscious public

health life with them.

Against that there is the problem of large areas with only a sprinkled population; the problem of how to cover those areas for public health services most economically and efficiently. There are many branches of public health nursing now, the district nurse, the school nurse, the industrial nurse, the infant welfare nurse, the tuberculosis nurse, &c., but it is not practicable to send four or five people long distances into the country to see two isolated families, when one nurse with a good all-round training and common sense could do what is required.

One specialized public health service of the country, a service that over a period of thirty-old years has had a most dramatic influence on the health of the people, and has increased their expectation of life, is the Plunkett nursing service founded by Sir Truby

King.

The service as it stands now consists of two branches; first the Karitane nurses who are trained to look after babies from two weeks to school age in the home; and second the Plunkett nurses, who having done their general training and usually midwifery as well, take a post-graduate course. There are, I think, about 10 Karitane hospitals scattered over the Dominion, but only one of these is a centre for the training of Plunkett nurses, and until the increase of population makes it inadequate, it is a good thing, because it does give a uniform standard of training. Of the Plunkett nurses, some return to their own jobs with the additional knowledge to help them; others are chosen to staff the Karitane hospitals, to teach mothercraft and train the Karitane nurses: others do district work, and here, though it would be a poor thing if a certain amount of individuality did not creep into the work of a district nurse, it is appreciated that the basic training of every Plunkett nurse in the Dominion is the same, and that a mother with a small baby moving from the north of the North Island to the south of the South Island can feel safely confident that she will get the same advice and guidance that she is used to.

The Karitane hospitals are not elaborately equipped with complicated apparatus and expensive labour-saving devices, but deliberately made to approximate the average home as closely and as attractively as possible, so that both the mother and the nurse can put into practice at home what they have learned working under the same conditions. No methods or equipment are used in hospital that cannot be translated to the poorest

home.

An interesting factor in the development of public health nursing in New Zealand has been the native population. The Maoris are a very fine race both in physique and intelligence. They share our schools and universities and our hospitals. Before we came they lived an open-air life, killed their own food and were a strong, virile people. With civilization came new diseases to which they were very susceptible. Their teeth, once

perfect, began to decay. Most serious of all, tuberculosis spread among them, and the Maori population started to fall. Then we realized our responsibility and tried to teach them how to live healthily under our conditions, with the result that the Maori population to-day is increasing, and is increasingly fit. Public health nurses work among them who speak their language and know their customs, but it is extraordinarily difficult to teach hygiene to a superstitious people who may have a deeply religious reason for doing something most revoltingly unhygienic.

Many of them still look on hospitals with suspicion, as places to die in, and though in time results will be convincing enough to penetrate their reason, one cannot wait for that penetration before admitting a case of acute diphtheria. At one time if a Maori was going to die in hospital, say of tuberculosis, and the relatives were notified, they would come 10 to 30 strong to take her home over miles of rough country roads to die among her own people. In the same way, if a case of typhoid was to be admitted from a country district, one automatically got at least 20 beds ready. The patient would arrive closely surrounded by all his friends and relations, in a buggy or truck, and they sooner or later would probably all be admitted themselves.

This may sound foolish to you. The obvious criticism is: "Why did you let them take home a girl dying of tuberculosis to infect the rest of the family? Why not send an ambulance to take the case of typhoid into hospital?" The answer is that by ordering them to do something they could not understand, perhaps to violate a tribal custom, we should have frightened and antagonized them, thus undoing the education and progress of 20 years by one act. Surely it was better to let them play our game their way until we could convince them that our way was best, even at the risk of spreading infection. In each of these cases the public health nurse could be sent to follow up the contacts—and could do it. But if we had been highhanded she would have lost the right of entry into their homes, and with it the privilege of helping them. In time their mistrust and fear, which is only a fear of the unknown, will disappear completely.

Miss Eleanor Jones, N/S (15th Canadian General Hospital, R.C.A.M.C., C.A. Overseas): In Canada three types of training for public health nursing are offered by recognized universities. There is the one year post-graduate course, the five-year course, leading to a degree in science, and the three-year undergraduate course in public health nursing which is offered by the School of Nursing of the University of Toronto.

The School of Nursing was founded in 1933, under the directorship of Miss Kathleen

The purpose of this new course was to provide a direct training in public health nursing. Previously, the training had been divided into two distinct parts, the three years spent in the hospital training, and the one year post-graduate training in public health. This new course combines those two parts and fuses them together into one well integrated whole.

The qualifications for entrance to the course are: Completion of secondary school education with a good background in sciences, good health, and a minimum age of 19. In an attempt to attract a better type of student, preference is given to those over 20, and with further education.

The first three months of the first year are spent in the classroom and the laboratory, and include an extensive course in sciences. The fundamentals of preventive medicine are studied, and a forty-hour laboratory course in infection and immunity is given. The principles of nursing and of public health nursing are taught, and the student is given the opportunity of observing the health work done in the community.

With this foundation, the student proceeds to various hospitals for her general training in bedside nursing. Experience is acquired in those clinical services of most value to the future public health nurse, such as obstetrics, pædiatrics, communicable diseases, psychiatry, and tuberculosis. Care is taken to protect the quality and quantity of work done in the hospitals, and constant supervision is given. Lectures and laboratory work continue throughout the hospital training, and the student nurse is constantly being brought in contact with the health work of the community through various agencies.

In the third year the senior course in public health nursing is given. This includes lectures and seminars covering such subjects as the principles and practice of public health nursing, the principles of teaching, social case work, and an intensive course in preventive medicine.

Approximately four months are devoted to field work with various public health agencies during this year. These include a municipal department of health, which does generalized public health work, a visiting nursing organization similar to the Queen's nurses, which does bedside nursing and health teaching, and the provincial Red Cross Society, which does generalized public health nursing in rural communities. Field

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work is done with a family case work agency. The staff nurses of these organizations supervise and teach the student nurses.

The course is thirty-nine months long, and meets all the State-registration requirements. On graduation the nurses receive diplomas which qualify them to practise both general nursing and public health nursing. They write the State-registration examinations.

This course was started as an experiment, and some of the funds for financing it were given by the Rockefeller Foundation. Although six classes have graduated to date, whose members are holding responsible positions in various public health agencies throughout Canada, it must still be considered an experiment, as it is constantly changing to meet changing demands. It is too soon to predict just what effect it will have on the future of public health nursing education.

Dr. Nicolas Gebbie (M.O.H. City of Kingston-upon-Hull): In the systematic development of the public health service in this country the health visitor, the school nurse and the tuberculosis visitor have played an important part and are destined to make an equally important contribution in the future.

We shall all agree with Prof. Chas. McNeil when he says: "The potential of service

that can be rendered to the people by trained health nurses is immense."

(1) The public health nurse.—The forerunner of the public health nurse as we know her to-day was the female sanitary inspector. In the days when environmental hygiene was the chief concern of the public health department and when little emphasis was placed on personal or individual hygiene the scope of activity of the female sanitary inspector was necessarily limited. Her pioneer work in the supervision of female outworkers and in the investigation of working conditions of women and girls in factories must always be recognized. It was not until measures of personal and social hygiene were begun, e.g. school medical work and maternity and child welfare, that the importance of nursing qualifications and experience was realized.

(2) The work of the public health nurse.—I need not recount the many and varied activities of the nurses in a modern public health department. The scope of the work of the nurses is ever widening and is likely to continue to do so, e.g. recent Scabies Order.

Home visiting is and must remain the most important duty of the public health nurse. In the early days these visits were resented by the mothers and it says much for the tact and ability of the pioneers that in a comparatively short time the house doors have been thrown wide open and the nurse has become a welcome visitor not only to the house but to the home.

The prams at the cottage doors in the summer sunshine are a lasting memorial to the work of the health visitors. The knock-knees and bow-legs of rickets are now practically limited to adults—unlucky enough to be born before the days of the health visitor.

The school nurse, too, relentlessly pursues her campaign to improve the cleanliness of the school children and has been affectionately dubbed "the nit nurse" in the process. Improvement in the standard of cleanliness of the school population has been most marked, but the revelations during the mass evacuation remind us that our task is not yet completed.

The tuberculosis visitor has also made her contribution to the betterment of the social welfare of her patients and their families. The part she has played in after-care

work has to be experienced to be appreciated.

The midwife, as a municipal officer, is of much more recent date than her colleagues. When the bill which became the Midwives Act, 1936, was being considered by the House of Commons, the then Minister of Health stated: "The midwife in future will be a member of our organized service. She will be an integral part of the public health service and no longer a lone figure in the campaign against maternal mortality".

(3) Training for public health work.—Before commencing her specialized training the student public health nurse should have had a sound training in nursing. Her appreciation of the social and domestic repercussions of the commoner ailments, some of which may cause long periods of disability, will be heightened if her training has included the

nursing of chronic cases.

The public health nurse, whether she be health visitor, school nurse, or tuberculosis visitor, is essentially a teacher. Her success in her profession will be measured by her skill as an educator of the public in hygiene. The student public health nurse should in my view, have reached a standard of education comparable with that demanded of entrants to the teaching profession in our elementary schools.

Scholarships should be available to permit of extra places for students who cannot afford to take their training. In such cases the capitation grant (£15) should remain.

The course of training should be of not less than twelve months' duration and should be eminently practical.

It should aim at preparation for interavailability. Interavailability is of great importance and with properly qualified, trained and experienced nurses it works well in practice.

The visitor can maintain a closer personal touch with the people in her smaller area. She has more scope for her teaching activities and can render greater services to those under her care. The school child, the adolescent and the adult are just babies of a larger growth. Duplication of visits by different nurses to the homes is avoided. The health visitor, the school nurse and the tuberculosis nurse should be one and the same person and should possess the health visitors' certificate. What about the municipal midwife?

In "Public Health and Social Services" by Dr. Geffen and Mr. Farrer Brown emphasis is laid on the part to be played by the midwife as a member of the public health team. "If the midwife is to use to the best advantage of her patients her opportunities to act as an educator and adviser on health matters, she must know what are the various branches of the public health and social services, the facilities provided and the appropriate person or authority to approach in any particular case. It is with a view to equipping midwives to make the most of these opportunities that the Central Midwives Board has required in the latest rules that pupil midwives shall receive instruction regarding

the public health and social services."

In the training of the public health nurse emphasis should be laid upon personal hygiene and social welfare. In the foreword to the book by the Ling Physical Education Association and entitled "A Modern Approach to Health Education" (published 1941 by the University of London Press) Dr. Gamlin, Chief Assistant School Medical Officer of Liverpool, writes: "The provision of more hospitals and clinics, the appointment of more doctors, nurses and health visitors would produce no spectacular improvements in the health and physical efficiency of our citizens until they recognize that the practice of individual hygiene is not only a duty but also a national necessity." The well-trained and experienced public health nurse will play a big part in securing the recognition by

the people of the importance of personal hygiene.

(4) What of the future.—The public health nurse must continue to carry the teaching of positive health right into the homes of the people. She will be the adviser and educator upon general hygiene, both personal and environmental, upon mothercraft and baby care, upon the health of the school child, the adolescent, the adult and the aged. This war has brought about an increase in communal living but the pendulum will swing back towards the individual home as the unit and towards all that that means to the British people. The standard of cleanliness of our people must be raised and the public health nurse will, I believe, succeed in raising it. Public health nursing must be made attractive to the best in the nursing profession. The remuneration must be adequate to ensure comfort and happiness in her work and security and contentment in her retirement.

In the Report of the Joint Consultative Committee of Institutions recognized by the Minister of Health for the training of Health Visitors and of Organizations of Health

Visitors, 1928-1937, there are the following conclusions:

"Of all the factors considered in this inquiry the salary scale is that to which most importance is attached by candidates for appointments. With few exceptions the number of applications received by individual local authorities in reply to their advertisements and the frequency with which they are obliged to advertise, varies directly with the salary scale offered. Where the minimum of the scale is more than £200 combined with a maximum of more than £250 there is no shortage of health visitors."

As regards age at retirement, 60 is old enough for anyone to be cycling round in all

weathers

The conditions of employment must be so arranged as to permit of ample relaxation and recreation and to include facilities for attendance at refresher courses, including instruction in the teaching of hygiene. The amenities and rewards of the public health nurse must be commensurate with the importance of her work to the nation.

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# Section of Surgery

President-E. ROCK CARLING, F.R.C.S.

[January 7, 1942, continued]

## Endothoracic Sympathectomy

By Squadron Leader John Hughes, R.A.F.V.R.

Endoscopy has in recent times become not only a well established, but also an extremely valuable branch of Surgery. Though primarily used as a method of diagnosis, by improvements in equipment and technique, it is now also possible by this means to perform operative measures of considerable magnitude.

The thoracic sympathetic nervous system may reasonably be regarded as one of the more inaccessible parts of the body, but viewed from within the pleural cavity, the sympathetic chain and splanchnic nerves are only separated from this cavity by the parietal pleura. The object of this paper is to describe the successful resection of the stellate ganglion and splanchnic nerves by an endoscopic technique. It is not intended to assess the value or otherwise of this treatment for the clinical conditions described.

The possibility of section of the splanchnics and excision of the stellate ganglion, via the thoracoscope was suggested during operations on the lungs. In the majority of such cases the roots of the great splanchnic nerve could be clearly seen glistening through the pleura, thus giving a direct guide to the position of the nerve, the position of the stellate ganglion was seen during operations for internal pneumolysis and gave support to the suggestion that such an operative approach was feasible.

Trial was made on the cadaver, and it became obvious that the simplest method would be to work with two cannulæ, one for the thoracoscope and the other for the passage of instruments. It was also obvious that it would be convenient to have two instruments that could be passed through the same cannula at the same time, one being a plain pair of forceps and the other a minute pair of scissors. These instruments were specially made, and proved sufficiently strong and satisfactory. Together with a small blunt hook, they are all that are required for use with the standard thoracoscope. It was also found on the cadaver, that the pleura could be picked up and cut with the forceps and scissors, thus exposing the underlying structures.

### TECHNIQUE

Both for the excision of the stellate ganglion and section of the splanchnic nerves, the preliminary essential is a complete pneumothorax on the side of the operation, induced over a period of some days, and checked by radiography. The operation for resection of the splanchnics is performed with the patient prone, and for the excision of the ganglion in a half-sitting posture. The position of the lung during each operation can be thus foretold.

For the splanchnic resection the patient is placed face downwards on the operating table and the thoracic cannulæ inserted under local anæsthesia between the 7th and 8th, and 8th and 9th ribs in the mid-axillary line. Using the upper cannula for viewing and the lower one for operating, the pleura is anæsthetized with 2% novocain by means of the long standard endoscopic syringe. An excellent view of the bodies of the vertebrae is obtained, and the diaphragm remains well down and the lung falls out of the way. The area of the parietal pleura which is infiltrated should cover the space of three vertebral bodies and also extend outwards to the necks of the ribs. It is interesting to note that the sensitivity of the pleura seems to diminish in a forward direction, so that while the pleura over the neck of the ribs is highly sensitive, the part which is reflected on to the mediastinum appears to be almost insensitive.

After infiltration, an assistant holds the viewing cannula and thoracoscope steady, so that both hands of the operator are free to manipulate the instruments through the operating cannula. The pleura is picked up at a convenient spot as low down as possible and cut with the scissors from the neck of the ribs to the front of the vertebræ. The pleura is elastic, and it is quite easy to pick it up and clean, without danger of damaging other structures.

The scissors are now removed, and the blunt hook inserted. With the forceps holding the pleura at the anterior end of the incision out of the way, the hook is passed towards that part of the vertebral body where it passes out of sight, and with a little gentle manipulation it is passed under the great splanchnic. The nerve is quite unmistakable when seen, as it can be drawn well forward and will spring back again like a piece of elastic. When seen through the thoracoscope it appears to be about the size of the median nerve at the wrist. The nerve is then grasped with the forceps and cut in two places as far apart as possible with the scissors. By gentle dissection at the side of the vertebral body,

the sympathetic chain can be cut in a similar manner.

For resection of the stellate ganglion, the patient reclines on the table so that the chest is at an angle of 30 degrees with the horizontal. In this position the lung falls downwards and backwards, leaving a good space in the region of the upper ribs. The cannulæ are inserted under local anæsthesia from the front this time, the viewing cannula between the 1st and 2nd ribs, and the operating cannula between the 2nd and 3rd, each being inserted about two inches outside the lateral border of the sternum. Using both the direct and oblique vision thoracoscopes, an excellent view of the dome of the pleura is obtained, and the line of the great vessels can be plainly seen, the veins, including the intercostals being particularly prominent. The pleura is infiltrated with local anæsthesia from above the neck of the 1st rib to the 3rd, and cut from below, upwards. The neck of the 1st and 2nd ribs are thus exposed. This area is then cleaned by careful dissection with the scissors and forceps, and the tissue removed kept for section. In one of the cases operated upon, the sympathetic ganglion was definitely seen, and its removal thus simplified; in the other it could not be identified with certainty, and a more extensive dissection had to be carried out. In both these operations as described above, the bleeding is negligible, and consists only of a very slight ooze from the minute vessels behind the pleura, which can be swabbed away by a small pledget of gauze held in the forceps.

Omnopon gr.  $\frac{1}{3}$  and scopolamine gr.  $\frac{1}{150}$  were used as premedication in four operations,

the fifth receiving morphia gr. 1 only.

Summary of cases.—The operation of sympathectomy by the endothoracic route was performed on four patients. In one case the procedure was carried out on both sides. It has thus been done on five occasions. Two of these cases had hypertension, in addition to which, one of them had coronary occlusion. One was a case of persistently painful amputation stump, and the other was a case of Raynaud's disease. The operations were all performed between 3.3.39 and 19.8.39. A short account of two cases is given.

Ars. C., aged 39, admitted to Sheffield Royal Infirmary on 27.2.39 on account of hypertension. Blood-pressure 238/140. Induction of artificial pneumothorax on the right side was commenced on the day following admission, and was complete by 3.3.39. The right great splanchnic was resected by the method described above. On the same day blood-pressure half an hour after the operation was 149/108 rising to 210/140 on the following day. It remained at this level until her discharge from hospital on 8.3.39. She was readmitted to Sheffield Royal Infirmary on 20.3.39 for a corresponding operation on the left side. This was carried out on 21.3.39, part of the sympathetic chain being removed at the same time. The stellate ganglion was resected on the right side only: the patient gave an excellent clinical result, with alteration of thermal and other conditions in the arm associated with section of the sympathetic supply. On admission the blood-pressure was 230/150, and on discharge on 6.4.39 was 216/136. Sections of the tissue excised were reported upon as follows: "Large non-medullated nerve." In this case there were no pleural adhesions, both lungs collapsed well, and from a technical point of view it was most\*encouraging.

Mr. C., aged 51, admitted to Sheffield Royal Infirmary 16.7.39. The right arm had been amputated just below the shoulder-joint, nine years previously for osteomyelitis of humerus. Two years ago pain commenced in the stump. A terminal neuroma had been removed with partial relief of the symptoms, but these had again become severe during the last three months. On 18.7.39 the stump was injected with novocain and on 21.7.39 another terminal neuroma was dissected out, with but little relief. It was then suggested by Professor Ernest Finch that removal of the stellate ganglion might be beneficial.

anglion might be beneficial.

Artificial pneumothorax was commenced on 9.8.39 and completed 18.8.39, when an excellent collapse was obtained. Endothoracic excision of the stellate ganglion was carried out on 19.8.39. The sympathetic chain in this case was identified behind the pleura. Histological examination of the tissue removed confirmed the presence of sympathetic

ganglion cells.

There was immediate cessation of symptoms after the operation, and the patient left the hospital free from pain. It was interesting to note that while the novocain was active at the site of the operation, the patient exhibited contraction of the pupil on the corresponding side, which disappeared in about two hours, but there was no permanent inequality of the pupils.

By using this method it would incidentally be perfectly feasible to inject the sympathetic with alcohol under direct vision, and if the pleura were allowed to heal, before the pneumothorax absorbed, there seems to be no reason why the procedure should not be repeated indefinitely.

All the cases were operated upon at the Sheffield Royal Infirmary, and I wish to express my gratitude to the physicians and surgeons under whose care they were admitted.

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## [March 4, 1942]

## DISCUSSION ON GROWTH AND NEW GROWTH

Mr. Harold Burrows: The influence of estrogens on cellular and organic growth.—When discussing stimulators and regulators of tissue growth, hormones derived from the testis and ovary are worth attention. Their composition is known, they are available in pure form for experiment, and examination of their activities has thrown light on some of the very many factors which govern cellular multiplication in vertebrates. Although the influence of these hormones is exerted mainly on the reproductive system, using this term in its widest sense, the nature and boundaries of their influence are not clearly marked.

The effects of œstrogen on the growth of tissues may be classified into three groups, tamely: (1) Controlled growth; (2) uncontrolled growth or cancer; (3) imperfectly controlled growth. In the last group are included fibromyomata of the uterus, ovarian cysts, chromophobe swellings of the pituitary and some other innocent tumours.

For brevity the subject of imperfectly controlled growth will not receive detailed attention in the following remarks.

## (1) CONTROLLED GROWTH.

(i) Prevention and arrest of growth.—Though a prominent function of estrogen is to stimulate cellular multiplication, in certain tissues it can also exert the opposite effect. For example, estrogen arrests the growth of epiphyseal cartilage, causing bony union between the epiphysis and shaft, which largely explains why women are smaller than men. The mammary ducts for their development, and perhaps for their existence, depend on estrogen, yet under excessive doses the ducts will remain stunted. Another way in which estrogen may hinder the growth of particular tissues is by checking the production of androgen and progesterone or by directly counteracting their growth-stimulating effects.

of androgen and progesterone or by directly counteracting their growth-stimulating effects.

(ii) Stimulation of growth.—(a) Cellular differentiation and function: A feature of normal tissue development in response to estrogen is its adaptation to a purpose, in attaining which cellular multiplication, differentiation and function follow each other in orderly succession and appropriate degree.

(b) Specificity of action: Estrogens apparently are not general stimulators of cell proliferation. Their action is mainly specific and is confined almost entirely to structures concerned, directly or indirectly, with sexual reproduction. This specificity is independent of the sex of the individual; homologous structures in the two sexes respond alike. It may be remembered that the formation of ostrogen is not confined to the female; males also elaborate and utilize the hormone.

(c) Responsive and irresponsive tissues: From what has just been said about specific action, it follows that different cells and tissues vary in their capacity to respond to estrogen. The degree and quality of this responsiveness is innate in each individual cell or group of cells, is unaffected by neighbouring cells, and is retained after transplantation into another part of the body or into another individual, whether of the same or of the typosite sex.

(d) Gradients of reactivity: The readiness with which different organs respond to estrogen shows wide divergences, and the threshold of reactivity may vary through a large range within the extent of a single organ.

(e) Reversible and irreversible effects: Many of the normal effects of estrogen are reversible and are maintained only while the hormone is supplied in adequate amount. Other effects are permanent, notably some of those seen in the course of embryological development. Mammary cancer is another kind of irreversible change induced by estrogen.

(f) Adaptational resistance to æstrogen: With continued exposure to æstrogen the individual may develop some degree of resistance to its action. This resistance is not attributable to the formation of antihormones.

(g) Inactivation and excretion: The liver seems to be the chief inactivator of estrogen the waste products of which are excreted in the urine and perhaps also in the bile; and hepatic disorder has been shown by experiment to accentuate the effects of artificially administered estrogen.

(h) Pituitary gonadal relationship: The production of estrogen in the body is normally controlled by the pituitary. Estrogen inhibits the output of gonadotrophin by the pituitary and so automatically checks its own production. Other gonadal hormones, including testosterone, restrain the production of estrogen by stopping the supply of gonadotrophin from the pituitary.

(i) Mutual antagonisms between different gonadal hormones: Either by a direct counteraction, or by indirect influence through the pituitary, the growth stimulating effect of estrogen on certain tissues may be prevented by other gonadal hormones, notably by androgens.

(j) Co-operation between gonadal hormones: On the other hand the co-operation of hormones may be required for the full development of a particular tissue. The co-operation takes place in one of two ways: either the hormones act simultaneously, or an organ must first be subjected to one of the hormones before the other can be effective.

(k) The effect of a given dose of æstrogen in an individual will be governed by many circumstances other than those already mentioned, including species, age, season, general health, diet and so forth.

It will be unnecessary to discuss every one of these just now. Perhaps it may be worth while to give an example of variation of response in different species. Fibromyomata of the uterus are readily induced in guinea-pigs by œstrogens but not as a rule in rats and mice.

### (2) Uncontrolled Growth

(i) Non-specific neoplasia.—Apparently estrogens have some power to induce cancer in tissues which are beyond the range of their normal specific activities, for sarcomas occasionally arise in rats and mice at the sites of estrogen injection.

(ii) Specific neoplasia.—Apart from these relatively unimportant instances the cancers induced by obstrogen are confined to those organs which are under the normal physiological influence of obstrogen. In this list may be included cancer of the breast, uterus, testis and bones. Among them, malignant tumours of the breast have been intensively studied in mice. The knowledge gained by this study may perhaps be applied to the investigation of other forms of cancer. An important fact concerning malignant disease of the breast is that, although a response to obstrogenic stimulation, it will not occur unless certain additional factors are present. Chief among these are two which are inherited, genic and non-genic.

(a) The genic factor is inherited as a Mendelian dominant, and may be defined loosely as a susceptibility to mammary cancer in the presence of the other two main factors.

(b) The non-genic factor is not carried by the chromosomes but is transmitted to the infant in the mother's milk. The factor can also be conveyed to the young by implantation of pieces of the mother's tissues. It seems probable that the transmissible agent is a virus; the liability to mammary cancer which it carries is handed on to subsequent generations and therefore, it appears, the agent must multiply in the body.

(c) Subsidiary factors.—Certain additional factors play a part in mammary carcinogenesis. These include diet and general health. By underfeeding mice on a diet that is adequate in quality, or by keeping mice on diets which are ample in quantity but deficient in certain qualities the incidence of mammary cancer can be reduced.

Perhaps some of the facts which have been mentioned and others concerned with the influence of œstrogen on tissue growth may be of interest in connexion with the stimulation of growth by carcinogens. If analogy may justify an opinion, it seems that the different forms of cancer which occur in the body might well be regarded as so many distinct disorders, each having its own special ætiology.

Another conclusion which seems justified is that tissue growth, whether controlled or uncontrolled, is regulated in vertebrates by a multiplicity of factors.

Dr. W. E. Gye: The capacity to grow and divide is a property of normal cells which lasts throughout life; an appropriate stimulus must be provided. Growth of normal cells and malignant new growth are different in a fundamental way; in malignant cells the stimulus to growth is within the cell itself and growth is not subject to the forces which control normal growth. These statements, drawn from the work of pathological study of human cancer and in particular of metastases, have been confirmed and amplified by forty years of experimental studies. Hence the popular attempts to cure cancer with extracts of glands and other tissues which are supposed to provide growth-controlling substances are based on misconceptions of the nature of cancer. There are, broadly speaking, two working hypotheses concerning the intracellular cause of the autonomous growth of cancer: (1) That the cancer cell is a mutant of the normal cell; (2) that the stimulus to growth in cancer is an intracellular virus. There is no factual evidence for the first hypothesis; the second hypothesis is supported by the fact that some new growths, epithelial and connective tissue tumours, are known to be caused by a virus.

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Mr. L. R. Broster: Growth.—Tissue growth and repair is the foundation of surgery, and we have been inclined to rely too much on Ambroise Paré's dictum, "I dressed him and God healed him", without looking towards its more obscure origins. What the stimulus to grow is—we do not know. As one of the basic instincts, we have to accept it like an axiom of Euclid—that it is an inherent property of living matter, and that it originates within the organism.

Phasic.—Growth is a dynamic and variable affair, intensely active during embryonic life, it continues rapidly after birth, bursts into activity again at puberty with the development of the secondary sex characters, and, maintaining a uniform level after the second decade, becomes dormant with age. It is a curious biological anomaly that with the waning of this normal growth process should correspond the rising incidence of abnormal or neoplastic tissue growth. It would seem therefore that we must look for some common biological denominator which determines growth, and from my own clinical experience of abnormal growth, I am led to the belief that it is primarily of a hormogenetic nature. This fortunately forms a line of study which is amenable to scientific investigation, and for this reason I propose to explore certain avenues of research which tend to confirm this assumption.

Adreno-genital syndrome.—Starting with our own work on the adreno-genital syndrome we have learnt that the masculinization of the female and the feminization of the male, are associated with a specific stain—the Ponceau Fuchsin Stain, discovered by Vines—In which the granules of adreno-cortical cells assume a vivid red colour, in contradistinction to the blue colour found in normal people. Backed by such a standard of comparison, my colleague, Dr. Jocelyn Patterson, has shown that both these conditions are associated with alterations in steroid metabolism. In virilism the urinary steroids are increased and in feminism they are decreased. By unilateral adrenalectomy the pre-operative level of steroid is diminished in both, and this is associated clinically by a tendency of these individuals to revert to the type of growth normal to their sex.

There are in both these conditions: (1) alterations in general skeletal growth and in special tissue growth involving taxally the secondary sex characters and cutaneous surfaces; and (2) disturbances in sex function, which somehow cannot be divorced from these growth factors.

Fætal growth.—Now it is obviously an anomaly that such abnormal growth as we have discussed should break out for no apparent reason in persons who were of normal stature previously. Consequently we reverted to the study of the fætus, and Vines was able to show that the same fuchsin stain is present in the cortical cells of the fætal adrenal in both sexes. It represents a transient "male phase" roughly between the 8th and 20th fætal weeks, stronger, more marked, and of slightly longer duration in the male than in the female. It seems reasonable therefore to correlate this event with the future outcrop of adult virilism. This "male phase" seems to mark the active functional integration of the fætal endocrine system.

Experimental embryology.—I must now take you into another channel—that fascinating work on experimental embryology carried out by Needham at Cambridge and by Ross Harrison and others at Yale. Briefly, if the left limb bud of a frog's embryo is amputated, and the right limb bud of another embryo is grafted on to it, the host embryo will force that alien right leg to develop into a perfectly normal left fore-limb. This will only happen up to a certain time, after which the host embryo loses this power, and the transplanted limb bud will grow according to its origin. Already at this early stage there is a diminution in the growth stimulus, but it shows that this growth-compelling power is inherent in the embryo, and that one group of cells possesses the power to regulate and determine the development of other groups of cells.

These workers conclude that the organizing ability is biochemical in nature—a hormone in essence, or a morphogenetic hormone" allied to the steroids and vitamin D.

Early in 1936, I performed an adrenal ectomy upon a woman (L. S.) who had had amenorrhoza for two years. She subsequently married, and we were fortunate in catching her by means of a positive Aschheim-Zondek test in the 8th week of pregnancy, when she contained excess of steroid. She was one of the exceptions to our series in that on the old biological test we could find no free male hormone either before or after her adrenal ectomy.

It is obvious then that if the growth-organizing capacity of the embryo is due to a morphogenetic hormone of the steroid group, the pregnant mother at the time of the fœtal "male phase" contains excess of steroid.

With regard to anti growth, Thompson and his co-workers in this country, working originally on parathyroid substances, have induced retardative growth effects on cancerous

and somatic growth. More recently they have found growth-inhibiting substances in the urine which contain one or more steroids.

Further evidence of what we may call "steroid growth" comes from the experiments of Dean Lewis and Geschickter of Johns Hopkins. Briefly, from bio-assays made of adenoma of the breast they have recovered large amounts of æstrin, and by injecting the latter directly into the undeveloped virgin breast, they have succeeded in producing mammary hypertrophy. However in their bio-assays of carcinoma they have not succeeded in isolating hormone with such pronounced properties.

Fætal integration. Intersexual growth.—If we accept the suggestion that the fœtal endocrine system bursts into functional activity about this time, perhaps we must modify our views upon chromosomal determination. It has long been known and has been stated by Crewe that the sex chromosome mechanism can be upset and the sex determined in other ways. It therefore seems probable that chromosome determination per se is shortlived and that its main functions, especially those of growth, are shunted on to the endocrine functions of several glands, for we get so many glimpses of polyglandular upset in the pictures of our patients.

The nearest approach we can get to this difficult problem is the *time table* of endocrine integration proposed by Vines. It is suggested that should a female directed embryo undergo an abnormally strong and long male phase, tissue growth can be so altered as to result in the many degrees of *intersexuality* which we have encountered clinically.

Pituitary growth.—So far we have considered growth in those cases where we have been able to apply a hormogenetic label; there is also growth of a similar kind in which no hormone is obtainable and for the want of better knowledge we must refer it to some pituitary thalamic mechanism. However, there is a definite hope that the two forms of control must meet on common ground, and the study of Cushing's syndrome

vaguely suggests there may be some reversible dual form of control.

A short while ago we published an article on the differential diagnosis of basophilism (Brit. M. J., 1940 (i), 425). The symptoms are the same, whether they be due to basophil adenoma of the pituitary, or hyperplasia or carcinoma of the adrenal cortex. So far no hormone has been recovered from those due to basophil adenoma, whereas steroid in the adrenal group is present in inordinate amount—one case of ours secreting the colossal total of 270 mg. per diem. Adrenalectomy cures the latter, whereas treatment of the pituitary lesion is still far from satisfactory. It is a curious anomaly that compared with virilism general growth in Cushing's syndrome is not so much affected whereas sex function is, and growth is directed more into the channels of a permanently pathological adiposity, which comes on quickly.

Carcinoma.—The subject of carcinoma arising from hormonal causes should be a stimulating incentive to future workers in this field. There is no doubt about the marked influence they exert on simple growth. Practically we must consider the subject still

sub judice.

It is a curious biological paradox that the cells of carcinoma, in their planless riotous growth, should not only recapture the energy for growth displayed in embryonic life, but at the same time free themselves from the "organized growth direction" of their host. By killing their host and themselves they behave like parasites, but at the same time they retain their physiological function. This function disappears with the removal of the primary growth but reappears with the formation of secondary deposits, and the majority of these tumours possess strong endocrine properties. It seems justifiable to assert therefore that the study of malignant tumours is more likely to be enhanced on physiological lines than on the old anatomical ones.

Mr. P. B. Medawar: Biological aspects of the tumour problem.—The foundation of experimental cancer research is the belief that its various lines, like the lines of perspective, converge somewhere to a point. A tradition as old as cancer research itself has it that this point lies within the domain of biology, and that the tumour problem is in some vague but important way a biological one.

The simplest, oldest, and most persistent of biological theories about tumours may be expressed as follows: tumours are essentially collections of cells which have escaped from the growth-controlling influences of the body. This is perhaps no more than a formulation of the tumour problem in biological terms; a formulation which is not self-evident, and which, in all probability, is not correct.

(1) The relative rate of growth.—The most striking feature of malignant tissue is its relatively high rate of growth. It may grow quite slowly, and yet multiply itself faster

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than the tissues of the remainder of the body. It is now widely agreed that a relatively high rate of growth is not (from the ætiological point of view) a critically important character of tumours; and it is worth while setting down the specific grounds upon which this general opinion is founded.

Organisms change in shape as they develop. Up to the time when the main organ systems of the embryo have been blocked out, these changes of shape are brought about less by growth (in the conventional sense), than by the streaming movements of cells and the convolution and folding of the various epithelial layers of which the embryo is primarily composed. Thereafter, changes of shape are chiefly determined by the differential growth rates of the organs themselves. Clearly, there must be some order and coherence in the process by means of which a final characteristic shape is reached, and D'Arcy Thompson (1917) and Huxley (1932) have made fundamental contributions to our knowledge of it. As a general rule, the specific growth rate! of part of an organism bears a constant ratio, over significantly long periods, to the specific growth rate of the whole. If this ratio is greater than unity, we speak of a "positive allometry". Some organs, like the antlers of deer and the claw of the fiddler crab, have remarkably high ratios of relative growth. If these organisms grew very much larger than they do, mechanical and other factors would bring about, or at all events facilitate their destruction in the course of natural biological competition. Speaking of the fiddler crab, Huxley remarks that one whose body weighed 1 kg. would theoretically bear a claw weighing 10 kg.: "It is perhaps no coincidence that the largest fiddler crabs attain sizes far below those of many other Brachyura, and even far below those of other land or semi-land crabs." The moral to be drawn from this is that there is a point in the course of normal growth beyond which, while precisely the same "growth laws" are obeyed (indeed, because they are obeyed), growth becomes abnormal and deleterious. Factors similar to this are thought to have been partly responsible for the extinction of the giant armoured reptiles of the Mesozoic. But there is nothing malignant about this sort of growth—in the technical

(2) Senescence and the damping-down of growth rates.—Part of the biological problem of cancer may be approached through that of senescence (cf. Crap er, 1932). Some tumours may be propagated indefinitely by cellular homoplastic grafts, an immortality which (in a rather modified form) they share with normal somatic cells and with societies of non-cellular organisms (see Jennings, 1939). We can express the problem of senescence, in so far as growth phenomena provide a picture of it, in the following more or less formal way. In a constant environment—an environment which has to be kept constant -growth proceeds by compound interest; either something near continuous compound interest, as in the case of colonies of yeast grown in a suitable perfusion apparatus (Richards, 1928); or discontinuous interest, as in the case of tissue cultures, which undergo a microcosmic cycle of growth and senescence in their culture cells until their medium is renewed and the cycle starts afresh. But in actual development, the rate of self-multiplication of tissue does not remain constant; it falls off throughout life. In technical language, the specific acceleration of growth is always negative (Medawar, 1941). The rate at which the rate of self-multiplication falls off was regarded by Charles Minot (1908) as a measure of the rate of ageing; and it is in this sense alone that I believe the problem of senescence to be related to that of cancer. If we can find out why the multiplication rate of tissue falls off in this way, we shall know in what terms to express the empirical fact that in normal development, growth does not proceed beyond a certain point. There are several ways in which we can measure this process of falling-off. For example: if we remove pieces of the heart of a chicken embryo at various stages in its development, we find that their power of resistance to growth inhibition falls off exponentially, in the way that heat is lost from a cooling body (Medawar, 1940). It takes about twice the strength of a standard inhibiting substance to hold the growth of six-day old tissue in check as it does to suppress growth from an eighteen-day old tissue. What happens in the meantime? Is the process irreversible; are the tissues losing a capacity for unlimited free growth which they only regain when they become malignant? Curiously enough, it has only quite recently been possible to give a clear-cut answer to this question. The answer is No. For if we cultivate tissue from an older embryo, its power of resistance to chemical inhibition rises sharply, and it returns in this respect at least to an earlier embryonic state. It has likewise been elegantly shown (Hoffman, Goldschmidt, and Doljanski, 1937) that tissues explanted from donors ranging from six days to a year in age do not differ appreciably in their capacity for growth; they merely take an increas-

<sup>1</sup> The specific growth rate is simply the growth rate divided by size; 1/W dW/dt instead of dW/dt.

ingly long time to set about it (Cohn and Murray, 1925; Suzuki, 1925; Goldschmidt,

Hoffman, and Doljanski. 1937).

There is therefore nothing irreversible in the consequences of differentiation (in mesenchyme cells) in so far as they affect the capacity for growth. Is the falling off of multiplication-rate in vivo due to some "intrinsic" change in cells, or is it due to some externally imposed and actively maintained growth-inhibiting influence? Both factora may play a part. But there is certainly no simply-extractable contact hormone in adult tissue which directly restrains the growth of cells. Though it has been said (Walton, 1914; Heaton, 1926; Brues, Jackson, and Aub, 1936) that adult liver tissue contains an inhibitor for explanted mesenchyme cells, saline extracts of most adult tissues tend on the whole to stimulate growth (Trowell and Willmer, 1939; Hoffman, Tenenbaum, and Doljanski, 1939). Tissue-culture experiments on growth-inhibition are by no means easy to evaluate. Carrel and Ebeling (1921; 1923 a, b) maintain that serum contains a lipoidal (Baker and Carrel, 1925) inhibitory principle whose concentration increases with the age of the serum. It is difficult to attach much significance to these results. Finely emulsified lipoids, such as they used, may well inhibit tissue-culture growth for quite non-specific reasons (e.g. surface activity: see Katzenstein and Knake, 1931); and it is in any case likely, as colloid theory suggests, and as Mayer's experiments (1936) directly prove, that emulsified lipoids occlude the growth-stimulating proteins of embryo extract. In either case we are dealing with a colloid phenomenon of no special significance.

Nevertheless, it has been conclusively shown that the lag-neriod before outgrowth in vitro which (as we said above) chiefly distinguishes adult from embryonic tissue growth, can be reduced without killing the cells by careful digestion of the tissue with trypsin or papain (Simms and Stillman, 1937). The experiments indicating this effect were devised in such a way as to exclude the possibility that tryptic digestion merely liberates growth-stimulating peptones and polypeptides (Baker and Carrel, 1928, a, b); and they likewise exclude the possibility that it liberates permeability-increasing factors which stimulate leucocyte activity (Menkin, 1936; Duthie and Chain, 1939). It is likely, then, that there is a non-diffusible protein in the intercellular fluids of adults that discourages the inception of free growth. Tumour cells, it should be noted, seem to lack the growth-inertia of adult tissues, though they do not necessarily grow very rapidly (Doljanski and

Hoffman, 1940)

Experimental results such as these have been used as evidence for the doctrine (see, for example, Murphy, 1936) that there is a dynamic balance of opposed growth-controlling influences in the body, and that in the induction of tumours, this balance is upset. I cannot understand this view. The evidence I have quoted above indicates that if such a balance exists, it is struck between more growth and less growth—not between malignant growth and normal. This is also, in the main, the conclusion we draw from studies on endocrine and other systemic factors influencing growth.

One alternative to the view that the growth of developing cells is immediately controlled from without is that they themselves undergo a gradual change in the type of metabolism associated with growth. I have discussed some aspects of this problem elsewhere (1940);

it belongs essentially to the biochemical field.

(3) "Regulation" phenomena; over-compensation.—None of the evidence we have so far considered seems to be directly relevant to the tumour problem, although some of it purports to be. The stepping-stone between normal and malignant growth has been laid down in imagination but not in fact. We may therefore turn to a third phenomenon of natural growth that has found a place in cancer actiology as the stepping-stone we are

looking for.

It is true, as a general rule, that the organism is capable of making up for the consequences of normal or artificial growth inhibition by a sudden burst of recovery growth when the inhibitory stimulus is released. To distinguish this phenomenon from normal regeneration (to which it is obviously closely allied) and from compensatory hypertrophy in the usual sense, I shall call it post-inhibition growth rebound. Four examples will show how widespread a phenomenon it is. Spear (1928) has shown that if mitosis in tissue cultures is brought to a standstill by temporary cooling, the loss of growth time is made good by a vigorous rebound on restoring the tissue to the incubator. Amblystoma larvæ, though not perhaps the larvæ of all amphibia, behave in the same way when cooled for varying periods from 22° to 6° C. (Buchanan, 1938). In his quantitative studies on the rate of healing of wounds, de Nouy (1936) has pointed out that retardation of growth by infection is, in favourable cases, very largely adjusted by the relatively vigorous growth that follows when asepsis is restored. This is what we should expect, since Przibram (1917) has shown that the rate of regeneration of lost tissue tends to be proportional to the amount of tissue that has been lost.

A somewhat similar phenomenon occurs on a larger scale than this. If the calorific intake of young rats and mice is reduced for not too long a time below the level required for normal growth, re-feeding brings about a spectacular burst of recovery growth that takes the experimental animals back to or even beyond the size of their controls (Osborne and Mendel, 1916; Clarke and Smith, 1938; Jackson, 1939). These experiments should be more widely known than they are.

In each of these instances we are dealing with the same type of physiological reaction: a burst of growth following artificial suppression which makes good the loss of growth time. Students of growth are familiar with the theory (see Haddow, 1935, 1938) that there is a marked correlation between tumour formation and the consequences of growth inhibition. Yet I do not think that this is the stepping-stone we are looking for. Post-inhibition rebound is a very widespread phenomenon; malignant growth is not known to be one of its consequences. Unfortunately, we cannot explain it, even in the most general terms, for lack of what we may call an adequate kinetic picture of growth. It is worth while mentioning that inorganic systems can be made to show an exact analogy to the phenomenon of post-inhibition rebound; and it is in this connexion that I should like to explain why I believe that the doctrine of growth-controlling factors, and the belief that cells stop growing because something stops them, is not self-evident, even if it is true.

We are so deeply influenced by the spirit of Newton's First Law that we tend to think that whenever a rate falls off, something is actively suppressing it. This is true of rates of motion, but it is not true in quite the same sense of the rates of a type of change which we may call changes in probability states. The rate at which heat is lost from a cooling body is initially high, and falls off as its temperature approaches that of the environment. The rate at which the distribution of molecules in a closed diffusion system tends towards uniformity is likewise rapid at first, and slower and slower thereafter. In these cases, and in others similar to them, we are dealing with rates which fall off "of their own accord"; with systems that tend to a certain, most-probable, state at a rate which depends upon how far they have yet to go to reach it. We may look in vain for inhibitors and controllers; they are not there.

We can use one of A. J. Lotka's (1925) statistical models to illustrate the type of change I am referring to. Suppose we start with two urns, one containing 50 black balls and the other 50 white, and at regular intervals remove blindfold one ball from each urn to replace in the other. After the first exchange, we necessarily have 49 balls of one colour and I of the other in each urn; and at the second exchange it is most unlikely (2499:1) that we shall be lucky enough to restore the status quo by exchanging the one white ball now in the black urn with the black ball in the white urn. But as swapping proceeds, it becomes increasingly likely that we shall remove from the originally all-black urn one of the white balls that got there on a previous exchange, and vice versa; so that the rate at which the most-probable-state (25 balls of each colour in each urn) is reached tends to slow down after being comparatively rapid at first. Multiply the number of balls a billionfold, and we have a model of the process as it takes place on a molecular scale. It is easy to construct statistical models illustrating regeneration phenomena (e.g. why a regenerating part grows to its right size, and no further), post-inhibition rebound, Le Chatelier's Theorem, and so forth. The models do not "explain" the phenomena in question, but they do suggest a way in which we can think about them.

I do not know whether what I have called the "kinetic picture" of growth will be found to fall within the domain of statistical mechanics, and I am not trying to substitute Maxwell's Demon for the demon of cancer. It is simply a picture we should try and keep in mind when thinking of growth processes, lest we should come to regard the doctrine of growth-controlling factors as self-evident, which it certainly is not. Carcinogenesis is the inception of a heritable capacity for growing under conditions in which other cells do not do so. This does not imply that normal cells are those which are somehow held in check.

(No more does it imply that a gene-mutation has been at work. Inheritance between organisms and between cells related to each other by mitotic descent are quite distinct from one another. After histological determination in the embryo, the tissue-cells breed true: epidermal cells divide to give epidermal cells, polymorphs to give polymorphs. Even tissues cultured for thousands of cellular generations maintain a characteristic modification of their histological type. Tumour cells likewise breed true, in vitro as

<sup>1</sup> Haddow's theory is expressed in a form much less general than this; it is only the principle we are examining here.

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in vivo. If we assume that tumour cells are genetically distinct from normal cells, we can hardly deny that skin cells are genetically distinct from those of the liver. But this violates the fundamental theorem of developmental mechanics, which is that the cells of an organism have the same chromosomal make-up. The evidence of experimental embryology (see Needham, 1936); striking instances of de-differentiation in tunicates accompanied by a conversion of one cell-type into another; endocrine sex-reversal; heteromorphosis in crustacea and insects—all these show that no genetic factor is directly involved in the assignment and maintenance of histological type in cellular heredity. That the genecomplex reacts in different ways to different environments is a different matter. mutation theory will be widely accepted when evidence has been found for it, and when certain difficulties of a purely genetical nature, concerning the extraordinarily high mutation-rate it implies,1 have been satisfactorily resolved.)

To sum up: the growth of somatic cells resembles, or can by artificial means be made to resemble the growth of tumours in certain definite ways, and these ways do not provide us with the information we need for making a critical distinction between normal and malignant growth. In particular, tumours are not merely cells which have escaped from the growth-controlling influences of the body; or which have an excessively high rate of relative growth; or which have acquired a sudden malignant access of energy as a result of prolonged inhibition of their growth. Tumours are not merely anything. At the same time it should be said that experiments of the type quoted in the second section of this paper have by no means exhausted their significance for tumour theory, even if the significance is only indirect, and even if they relate to the properties of tumours already formed rather than to the problem of tumour formation. To link up some hitherto uncorrelated lines of research, we might investigate the fact that tumours, with a low growthinertia, take comparatively well as homoplastic grafts, while adult tissues, with a high growth inertia, do not.<sup>2</sup> It is known on the one hand that careful proteolytic digestion of tissue abolishes the growth inertia in question; and on the other hand there are indications that tissue-storage reduces the intensity of the homograft reaction (Sanders and Young, 1942). Does the storage of tissue abolish the lag-period of adult tissue growth, and can proteolytic digestion be used to mitigate the homograft reaction? If they do so, we shall be able to establish a set of correlations with more than a remote bearing on the tumour problem, and of some interest for general surgery. But as hypotheses like these can be checked by simple direct experiments, it is not worth while pursuing them further in theory.

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<sup>11</sup> am grateful to Mr. E. B. Ford for pointing this out to me.

<sup>2</sup> The approach to the problem of tumour transplantation through that of surgical homoplastic grafting and of "individuality differentials" is largely due to Loeb, who has reviewed it (1930, 1937; see also Woglom, 1929). Murphy (1926) and others believe that the lymphocyte reaction of homoplastic grafting is of fundamental importance in determining the resistance of the recipient to transplanted tumours.

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Dr. F. Gordon Spear: This paper summarizes part of an investigation by Dr. A. Glücksmann and myself which is being made to determine the changes in cellular activity after graduated doses of irradiation, in the course of which a number of normal and malignant tissues have been examined histologically before and after exposure. Since changes in cellular activity, whether spontaneous or imposed, must precede alterations in the tissue as a whole these changes should have a prognostic value.

(1) Observations on unirradiated normal tissue.—As an example of a relatively simple tissue we may take a hanging drop culture of fibroblasts which presents a form of growth consisting only of proliferating or of potentially proliferating ("resting") cells. In such a culture successive cell divisions lead to the symmetric outgrowth of undifferentiated cells in all directions (fig. 1a).

In the organs and tissues of growing embryos, proliferation is associated sooner or later with differentiation but the two processes are separated either in time or in space. For example, in the mammalian eye (human and rat) a period of proliferative activity is followed by a differentiation period during which cell division is suspended (fig. 1b).

In the frog tadpole eye, on the other hand, the central parts are fully differentiated and functioning, while proliferation still continues in the peripheral region, i.e. the two processes are separated spatially. In this case, about half the number of daughter cells which result from cell divisions remain in the germinative zone for subsequent division, while the rest migrate away and differentiate (fig. 1c).

Other examples of the spatial separation of proliferation and differentiation are found in the intestinal crypts, the hair follicles, and the stratified epithelia of many adult animals.

In all these cases the processes of proliferation and differentiation are mutually antagonistic; the differentiating cell does not divide.

(2) Observations on unirradiated malignant tissue.—The carcinogenic changes brought about by painting mouse skin with benzpyrene include not only a stimulation of proliferative activity but also interference with the differentiation processes of repair. Loss of hair and the destruction of skin appendages caused by the initial paintings are followed by the appearance of abnormal hairs and the formation of sebaceous glands at abnormal sites. With continued painting the stimulation to proliferation is maintained, together with the disorganization of the processes of differentiation, leading to an abnormal regenerative activity in which the clear-cut antagonism between the processes of proliferation and differentiation is lost. The basic tumour cell, unlike the normal proliferative cell in the germinative zone, exhibits some degree of differentiation while retaining its proliferative capacity. The degree of differentiation is slight and it is still possible to speak of the potential dividing malignant cell as a resting, or (relatively) undifferentiated, cell by comparison with the more fully differentiated tumour cell which is no longer a potential mitotic cell. These terms are relative to whatever tissue they are applied, e.g. the "resting" cell of normal growth is itself more differentiated than a very primitive embryonic cell.

However the malignant cell may have originated, considered from the point of view of cellular reaction to abnormal stimuli, malignant growth does not appear as a mass of irregular and lawless cells entirely dissimilar in behaviour to the normal cells from which the tumour arose. In the majority of tumours it is quite easy to recognize areas of proliferative activity in the advancing edge of the tumour, and if these areas are examined by quantitative histological methods almost any tumour shows a surprising constancy in cell behaviour in each of these regions. The proportion of dividing (M), resting (R), differentiating (Df) and degenerate (Dg) cells determined for any one growing area of a tumour is typical for the other growing areas of the same tumour (see table).

TABLE SHOWING RESULTS OF QUANTITATIVE HISTOLOGICAL ANALYSIS OF DIFFERENT GROWING AREAS OF THE SAME TUMOUR.

DE	differentiating	cells	M	mitotic	cells.	R	resting	cells.	Dø	degenerate	cells

Sample		Total o	counts:			Percentage:				
No.	Dí	M	R	Dg	Df .	M	R	Dg		
1	7	14	259	25	2	5	85	- 8		
2	11	13	388	32	2	3	88	7		
3	8	7	286	24	2	2	89	7		
4	11	10	213	24	4	4	83	9		
5	7	10	218	28	3	4	82	11		
6	8	9	234	22	3	3	86	8		
7	8	7	204	25	3	3	84	10		
8	10	8	219	27	4	3	83	10		
0	0	0	010	10	A	4	9.4	0		

The variation seen in other regions of the tumour is a result of the ageing of cells (advanced differentiation), death of unstable cells, and changes due to alterations in the circulation or in the tumour bed. Comparison of such parts shows no constancy either qualitative or quantitative.

When the growing areas of a series of growths are analysed quantitatively, different tumours, at present included within the same pathological classification, are found to vary in the proportion of differentiating cells which these areas contain, and also in the ratio of dividing to non-dividing cells. The relation between differentiation and proliferation can, indeed, be used as a basis for classifying tumours in terms of cellular behaviour, and such a classification is beginning to be of practical use.

In a rodent ulcer, for example, the active cells divide but do not differentiate (fig. 2a). In a keratinizing or a parakeratotic squamous-cell carcinoma on the other hand, the cells may either divide or differentiate (fig. 2b). The ratio of proliferating to differentiating cells varies from one type of tumour to another, and the tendency is for differentiation to be less advanced in the tumours which show the greater proliferative activity (fig. 2c).

The differentiation which occurs in a malignant cell is not of a normal type, and the cell, being unable to function, eventually degenerates, though a considerable time may elapse before it disintegrates. Many undifferentiated cells, on the other hand, survive only a relatively short time and break down in the process of mitosis. The rodent ulcer which appears to consist solely of potentially dividing cells is actually of low malignancy owing to the number of cells which degenerate through lack of nutrition or some other cause when division is attempted. A more malignant tumour is one whose cells exhibit a low degree of differentiation and survive without losing their capacity to proliferate. The parakeratotic basal-cell carcinoma is an example of this type of growth.

(3) Observations on irradiated material.—The significance of cellular activity in the youngest areas of both normal and malignant growth in determining the ultimate character of the tissue is emphasized after exposure to sublethal doses of radiation, which inhibit one form of activity without preventing some alternative behaviour.

At the lower dose levels (100 r—1,000 r) irradiation of a tissue culture with gamma or X-rays has the effect of delaying the onset of cell division with subsequent breakdown when mitosis is attempted. Thus a diminution in mitosis is followed by the appearance of degenerate cells in place of dividing cells, and the amount of degeneration is proportional to the number of premitotic cells present at the time of irradiation.

A similar result follows the irradiation of the rat eye in the proliferative period, with little or no effect (at this dose level) on the cells which have differentiated.

In the case of the tadpole eye, where proliferation and differentiation are occurring simultaneously, a cell prevented from entering division may be induced to differentiate instead. In these circumstances the diminution in mitosis is followed by a small amount of degeneration and an increased amount of differentiation which is the alternative to a cell attempting division and breaking down.

Malignant cells also vary in their response to radiation according to their activity at the time of exposure. After irradiation proliferating cells of a rodent ulcer break down in greater numbers, giving a wave of degeneration which replaces the mitotic activity characteristic of the growth.

In the case of the squamous-cell carcinoma, where the processes of proliferation and differentiation occur simultaneously, the diminution in mitosis is accompanied by increase in differentiation. Significantly enough, the parakeratotic basal-cell growth is the more difficult to deal with radiologically by present methods than either of the other two types of malignant growth. The inhibition of mitosis does not seem to induce the degree of differentiation necessary to exclude the possibility of subsequent mitotic activity.

Observations on the limited amount of material so far examined suggest that any estimation of the character of a tissue, normal or malignant, or of its likely response

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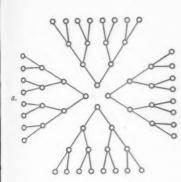
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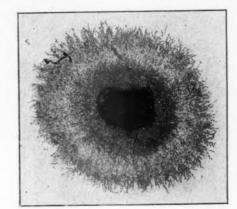
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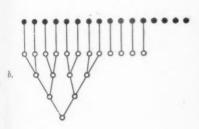
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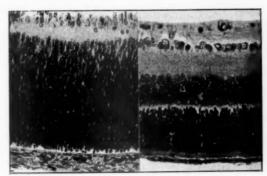
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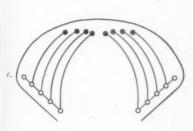


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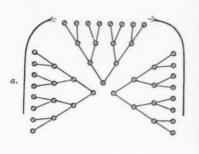
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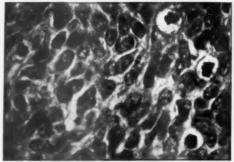
FIG. 1.—Growth and differentiation in some normal tissues shown diagrammatically (left) and photographically (right). a. Tissue culture: proliferation among undifferentiated cells. b. Rat eye: 2-day eye in stage of proliferation (on left); 10-day eye in stage of differentiation (on right). e. Frog tadpole eye: proliferation and differentiation occurring simultaneously.

O = resting cell.

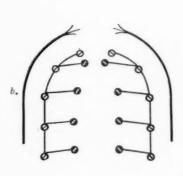
O = dividing cell.

differentiating cell.

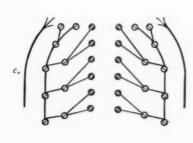




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FIG. 2.—Growth and differentiation in some malignant tissues. a. Rodent ulcer: scattered mitotic figures among relatively undifferentiated cells. b. Squameous cell carcinoma: differentiating cells centrally with resting and dividing cells peripherally. c. Parakeratotic basal cell carcinoma: degree of differentiation much less marked.

0 = resting cell.

et = dividing cell.

= differentiating cell.

The broken line represents the basement membrane.

to radiation, or any other agent, must be made not in terms of proliferation or differentiation considered as isolated processes, but in terms of the quantitative relation of these two processes to one another in carefully selected young areas of the tissue.

Dr. Alex. Haddow: This discussion has so far dealt with one or other aspect of normal growth, as also with the processes of wound healing, regeneration and hypertrophy, and with the long-continued maintenance of non-malignant cells in vitro. The factors which normally restrain the potential growth-capacity of normal cells in vivo are in part associated with the degree of cellular differentiation, and in part with the density of the cell population. The importance of the latter condition is well shown in Wigglesworth's studies of the healing of wounds: migration of cells towards the wound defect produces a relative sparsity of cells at a distance, and this permits the division of the cells in that area to a point where the normal cell numbers are approximately restored. From these considerations it is clear that the growth of malignant cells is not strictly a new or unique character, but rather the permanent unmasking of a property possessed all along by their normal prototypes. The outstanding feature of the malignant cell lies rather in the manner in which its heightened growth-rate is persistently maintained, being only slightly affected by environmental factors which normally contribute to the restraint of cell-division. As Dr. Gye has said, the course of malignant proliferation is limited simply by the life of the host, and may be extended indefinitely by serial transplantation.

The change from the normal to the malignant state is essentially an irreversible alteration of the cell. Furthermore, when its induction is brought about by chemical means the malignant variant appears (1) not merely freed from the "normal" restraining influences, but also (2) independent of the continued presence of the carcinogen, and (3) resistant to the effects produced by the specific carcinogen on normal cells. last effects, which it is presumed are the changes which instigate the malignant transformation, are essentially inhibitory in nature. Dr. Medawar, in quoting examples of the well-known phenomenon which may be called "post-inhibition rebound", has shown that this process can have little significance in the problem of the induction of cancer. The proposition would seem self-evident, since the great majority of agents which temporarily interfere with growth in such a way as to permit an early recovery or rebound -with or without compensation-are not carcinogenic. It has been reliably shown, on the other hand, that the carcinogenic hydrocarbons produce an interference with growth which is relatively persistent, so that the usual process of complete recovery is less easy and becomes progressively more difficult. It is in these circumstances, I would suggest, that the adaptation effected by the cell takes the form of a discontinuous and irreversible variation involving chiefly and usually a lowering of differentiation, and conferring automatically a proportionate and permanent enhancement of the rate of growth. considerations depend for support on the substantial correlation which has been shown to exist between (1) the capacity to produce this type of growth-inhibitory effect, characteristic if not specific, and (2) the power to induce tumour-formation, in the carcinogenic hydrocarbons and groups of allied compounds, of which several hundreds have now been

To many interesting chemical and biological relationships between carcinogenic and estrogenic compounds may be added the growth-inhibitory and carcinogenic properties which have been ascribed to estrogens, and certain of which have been alluded to by Mr. Burrows. In this connexion it may be significant that certain synthetic estrogens (e.g. derivatives of triphenylethylene) may exhibit a structural or skeletal resemblance to cyclic compounds derived from 1:2-benzanthracene. The same type of approximate similarity of molecular arrangement (in this case to the synthetic estrogen diethylstilbæstrol and the carcinogenic hydrocarbons 3:4-benzpyrene and 1:2-dimethylchrysene) is shown by  $\alpha$ -ethyl- $\beta$ -sec-butylstilbene, a compound recently described by Dodds, Lawson and Williams as possessing slight carcinogenic activity in mice. Of related interest is our own finding that the polycyclic hydrocarbon 9-methyl-1:2-benzfluorene (synthesized by Dr. G. M. Badger) shows pronounced æstrogenic activity: the carcinogenic activity of this compound, if any, is not yet known.

As to the means by which carcinogenic substances produce interference with growth, various suggestions have been made from time to time by different workers. I would like to draw attention to certain current researches reported by Rhoads and his group, from the Memorial Hospital (e.g. J. Nutrition, 1941, 21, Supp. 1, 14; Bull. N.Y. Acad. Med., 1942, 18, 53-64; Cancer Research, 1942, 2, 1-10), which are of great interest in themselves, and may later prove to have an important bearing on this problem. In experiments involving a study of the metabolism of p-dimethylaminoazobenzene ("butter yellow"),

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gures g and ked. an azo dyestuff which Kinosita had previously observed to cause liver cancer in rats, Rhoads and his co-workers found that the administration of this carcinogenic substance injured normal liver cells by interfering in some way with at least one enzyme system essential for their normal chemical and biological function, and that this interference was probably of ætiological importance in the malignant transformation. It was further suggested that, while the oxidation processes of the normal liver cell are extremely susceptible to such interference, the development of the mutation which characterizes the malignant liver tissue is marked by the presence of an oxidizing enzyme system no longer susceptible to the inhibitory effect. It is obvious that there is a striking parallelism between these biochemical findings and the views I have already suggested on the physiological side, namely, that the formation of a chemically induced malignant tumour is brought about by a rather characteristic interference with the growth-capacity of the corresponding normal cell, and that the resulting malignant cell is so altered as to be resistant, for a time at least, to the inhibitory activity of the compound which provoked its emergence.

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# Section of Neurology

President—George Riddoch, M.D. [March 19, 1942]

# DISCUSSION ON DIFFERENTIAL DIAGNOSIS AND TREATMENT OF POST-CONTUSIONAL STATES

Air Commodore C. P. Symonds: I shall assume that we are discussing the individual who has recovered from the acute stage of his head injury and is now in the chronic, or ambulant stage.

The problem of differential diagnosis and treatment in such cases may be divided into two. First there is the case in which the neurologist has seen the patient in the acute stage and has been able to observe subsequent progress. This is relatively simple. The second type of case is that in which the patient is first seen in the post-contusional or ambulant stage. (Ambulant, of course, must not be taken too literally. In many of these patients there are associated injuries which necessitate their being still in bed.) These cases are not only the most difficult, they are also the most common. Patients with head injuries are usually admitted to the nearest hospital and it is generally some time before the neurologist sees them. What, at this stage, is the general nature of the problem? It is that of a patient with a variety of subjective complaints, little in the way of abnormal physical signs, and, regrettably often, a quite inadequate record of the early stages of his illness.

Accurate diagnosis and correct treatment in such a case are of the utmost practical importance and the problem is one which demands a considerable expenditure of time if we are to arrive at any satisfactory solution. Here at once is a practical difficulty. Cases of this type should preferably be seen by appointment, or admitted to hospital for obser-

Reconstruction of the injury.—Our problem begins with the reconstruction of the story of the injury, often with scant information apart from what the patient can tell us. Fortunately the retrograde and post-traumatic amnesias can be estimated with rough accuracy at this stage, but it is important, if we are going to use these estimates, that we should standardize our end-points as far as possible. The man's last memory before the injury is usually a reliable point for the retrograde amnesia, but there are sometimes difficulties. Recollection is influenced by factors apart from the injury, such as the significance for the individual of events in the preceding period. Were they events worth remembering? Dull or exciting? Commonplace or unusual? The estimate of retrograde amnesia to be of real value should be accompanied by reference to these points. The estimate of post-traumatic amnesia needs similar details of circumstance. Moreover the observer must decide whether his end-point will be the first memory after the accident, or the beginning of continuous awareness. Often these correspond, but when they do not, when the first memory is, so to speak, an island, the beginning of continuous awareness of the surroundings is the safer guide. It would be convenient if all neurologists would agree to use this measure in stating the duration of post-traumatic amnesia.

In relation to the measurement of post-traumatic amnesia, it is important to know whether or not the patient has been given morphia, especially in cases in which the total duration is a matter of hours.

Type of headache.—We next want the story of the patient's symptoms up to the time of our examination, in relation not only to the sequence of time, but the sequence of events. We want to know, for example, not only whether he had headache and what kind of headache, but when he first had it, how often, and under what conditions it was worse or better. What was the effect upon it of having visitors, of sitting up, or first getting out of bed? All these questions apply equally to giddiness, and to the state of thought and feeling. If he was depressed or anxious, when and in relation to what circumstances, reflections or anticipations? What has his attitude of mind been towards the accident and its aftermath and what have been the stages in the development of his present attitude? This leads naturally to the analysis of his present complaints. Subjective symptoms are many and important.

The more experience I have of traumatic headache the more difficulty I have in dividing it into clinical types. There is, it is true, a localized variety, usually in the neighbourhood of the site of injury, intermittent, short-lived, sharp or throbbing, and related to physical effort or change of posture. This, when present, is highly characteristic of local injury, but it is uncommon in pure form. As another extreme example there is the continuous,

dull, generalized headache, unrelated to any circumstance. Either type may be encountered in individuals whose injuries have been of comparable severity, whose symptoms in other respects are the same, and who are apparently of the same constitution and disposition. Between these extremes there are all kinds of mixtures.

Knowledge of the circumstances which induce or relieve headache, and of the symptoms associated with it when it is present, is generally more helpful in differential diagnosis and treatment than the character of the headache. I would take as examples headache induced by continued though mild physical effort, such as walking, and associated with sensations of fatigue; headache similarly induced by continued mental effort and accompanied by a feeling of mental fatigue; headache induced by an unusual degree of stimulation of one of the special senses, such as noise or light; headache associated with mood disturbance, such as irritability or depression. Headache may be prominent after a brief amnesia. It may be absent after a prolonged amnesia.

If the amnesia has been prolonged it is useless to rely upon the patient's statement at a later date that he has never had any headache. It is not uncommon for a patient to have complained of severe headache during the amnesic period. It is therefore important that the observer of the earlier stages should record in the notes the presence, or absence, of headache during this phase. If a patient has reached the ambulant, or chronic, stage without headache it does not follow that he will continue to be immune. It is by no means uncommon to find a man beginning to complain of headache when, it may be several weeks after the injury, he is exposed to additional stress, and this is especially apt to occur when the exposure is sudden. It is important therefore when a patient has been headache-free up to the time of examination to know under what conditions of mental and physical stress this freedom has been preserved.

Dizziness.—A high proportion of patients in the stage under discussion complain of giddiness or dizziness. Of these a small proportion only describe true vertigo. Thus, out of 1,020 cases of closed head injury in which the symptom was inquired for, it was found present in 82. In 29 of these the vertigo was associated with deafness of middle or inner ear type, dating from the injury, and in 4 others there was a history of bleeding from the ear, or tinnitus in the early stage. This leaves 49 in which there was no evidence of aural damage. Two of these had damage to the 7th nerve, suggesting a fracture involving the petrous bone. In the remaining 47 cases there was no evidence pointing to the labyrinth as the probable site of injury. Of these 47 cases it is interesting to note that in 7 there was a history or presence of diplopia and in 2 others nystagmus was recorded in the early stages, symptoms indicating the probability of brain-stem injury.

There remain 38 cases, nearly half the total number with vertigo, in which no evidence either of aural or brain-stem lesion was forthcoming. We may, however, assume that vertigo in the true sense is evidence of damage to the vestibular sense organ or its central connexions. It is important evidence of organic damage and I suspect that if inquiry as to the presence or absence of deafness and tinnitus on the one hand, and diplopia and nystagmus on the other, were more rigorous in the early stages, we should have fewer cases in which corroborative evidence of labyrinthine or brain-stem injury is lacking.

Generally the complaint is not of true vertigo but of a transient disturbance of balance and often of the visual sense, experienced on stooping, or rather on rising from the stooping posture. This is probably due to a defect of vasomotor adjustment, and in the light of the recent experiments of Denny-Brown and Ritchie Russell (1941) may result from medullary concussion. It is a common constituent of the post-traumatic syndrome.

There are other varieties of dizziness which are less easily placed. I would draw attention in particular to one which is often described as a "black out". The onset is sudden, there is dimness of vision and a sense of insecurity of balance which may result in falling, without any description of true vertigo. Consciousness is often momentarily disturbed and may be lost. The main features of these attacks are syncopal rather than epileptic. Nevertheless, in some cases after repetition there is a transition into epilepsy.

An officer, aged 22, was injured in an accident on 7.10.39. Retrograde amnesia a minute or two, post-traumatic—forty-eight hours. He sustained a longitudinal fissured fracture of the left parietal bone and abrasions and contusions of the right chin, nose and left forehead. He found on recovering consciousness that he had anosmia and diplopia and suffered severely from headaches in the first three weeks. Within three months of his accident he was back on light duty with only occasional headache. The anosmia had persisted. The diplopia had recovered. Shortly after he returned to duty he began to have attacks which he described as "muzziness", "you can't think as clearly as you would like, your hands get sort of clammy". It came on gradually and faded gradually after five to ten minutes. No spinning or sense of movement in space, and no feeling that he would lose consciousness at all. He paid little attention to these attacks, which were infrequent, but on 27.5.40 he had an attack beginning in this way in which he lost consciousness for five minutes.

There was no history of epilepsy in the family. He himself, as a child, after running on a hot day, had once fainted for a few minutes.

The E.E.G. was no promal.

fainted for a few minutes.

The E.E.G. was normal.

He was retained in the Service in a restricted category and in January 1941 was admitted to another hospital on account of frequent attacks in the past three weeks of loss of consciousness. These would be preceded by a feeling of depression for one to three hours, together with drowsiness. He would then suddenly look very pale and become unconscious for several minutes.

The diagnosis made by experienced observers was that of epilepsy.

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Mental disability.—Complaints of mental disability are, as a rule, classifiable under two headings. The patient tells us that in certain respects he is unable to perceive, remember and think as quickly and clearly as he could before the injury; and he says that somehow he feels different. Both kinds of disturbance are usually present in the same case.

There are many variations of this central theme, some more characteristic of brain injury than others. On the intellectual side, inability to enjoy reading for lack of power to hold the thread of the story, difficulty in grasping the war news, forgetfulness of small things, are significant. In the sphere of feeling the most typical complaint is of loss of interest and liveliness, but nervousness, depression and irritability are common. There are also cases in which the mood is elevated and activity increased. This patient often complains of nothing. His beaming smile and confidence of his own fitness are disarming and, at the same time, significant.

It is generally recognized that the family and personal history are important in assessing disability and guiding treatment. It is essential before we sum up the case that we should have at our disposal the main facts of the pre-traumatic personality and intellectual level, and know whether beyond this there are possibilities of an inherited and latent disposition to mental disturbance of a kind which may be precipitated by injury. There is as a rule more to be gained from this source than from a protracted neurological overhaul and the time available for examination should be distributed in accordance with these practical values.

## Neurological Examination

By the time our post-contusional patient is examined he is unlikely to show any abnormal physical signs. Nevertheless, routine examination may occasionally reveal something unexpected and important. Of such signs anosmia is the commonest. If this is complete it will have appeared in the patient's complaints as inability to smell and taste, but there are many cases in which it is not complete. Bilateral anosmia may be present in a man who is yet able to distinguish flavours reasonably well. Unilateral anosmia as a rule passes unnoticed by the patient until it is specially looked for. Our usual methods of testing are, of course, crude, but when there is inability to distinguish test odours, without local obstruction or inflammation to explain it, and with a previous history of normal capacity for smell, we may presume that the disability is the result of the injury.

There are two facts in this connexion which are perhaps not generally known. One is that traumatic anosmia is not uncommonly associated with occipital fracture. The other is that it may result from an injury without evidence of severe generalized cerebral disturbance.

Captain D. F., aged 27. On 20.11.41 at a sing-song he was attempting to seat himself on a mantelpiece when he slipped, falling on his back. He does not remember hitting his head, but probably lost consciousness momentarily. He got up, but felt dazed and went to bed. On waking next morning he had a "thick head", but no pain. He went on duty, which involved a long journey by car, during which he developed generalized throbbing headache, spreading down the back of his neck, nausea and eventually vomiting. He abandoned his journey and was admitted to hospital where meningitis was suspected. Lumbar puncture revealed a heavily blood-stained fluid with yellow supernatant fluid, and the diagnosis was altered to subarachnoid harmorrhage. Headache and vomiting continued for three days, after which he rapidly improved. He found, however, that he had lost his sense of smell and could taste nothing in his food but sweet and bitter. He was transferred to a hospital for head injuries on 11.12.41 feeling well, save for occasional slight headache on reading. The positive findings were complete bilateral anosmia; a fine fissured fracture of the occipital bone in the mid-line running to the foramen magnum, and some low voltage 1 to 2 a second waves in both occipital regions in the E.E.G. There can, of course, be no doubt that the subarachnoid hæmorrhage was traumatic.

In a series of 1,020 cases of closed head injury, anosmia attributable to the injury was found in 76; bilateral in 62 and unilateral in 14. Of the bilateral cases 30 complained of their inability to smell and 16 of these also complained of inability to taste. Bilateral anosmia in this series was associated with X-ray evidence of fracture in 42 out of the 62 cases, the situation of the fracture being most frequently frontal (26 cases), and next most frequently occipital (12 cases), usually a fissured fracture of the occiput running into the foramen magnum.

A lesion of the optic nerve may have been missed if the field defect is small. Visual acuity therefore should always be examined. Lesions of the infra-orbital and supra-orbital nerves are also not uncommon in fractures involving the roof of the maxillary antrum, or frontal bone, and may be better evidence of fracture than X-rays.

Dysphasia, hemiparesis or sensory defect, if they exist at this stage, will almost always have been detected and should have been recorded in the earlier and grosser stage. Signs of slight pyramidal damage may sometimes be found when least expected. Homonymous visual field defects will occasionally be missed if the method of testing by confrontation is omitted. Perimetry seldom yields anything of value if confrontation tests carefully executed are negative.

These observations will serve to indicate that the neurological examination at this stage should be intelligently guided. To include examination for dysphasia or dyspraxia,

perimetry or complete sensory investigation in the routine is a waste of time. On the other hand, failure to examine the sense of smell is a serious omission.

Psychiatric Examination

Intellectual impairment or personality disorder may be evident at the first examination and, if so, will of course be assessed against the estimate of the pre-traumatic state made from the history. The total situation must be taken into account, including the individual's adjustment, responsibilities, plans and ambitions before the accident and his reaction to the change in his environment and prospects following the injury. In many cases, however, a period of observation is essential before a just assessment can be made. This is equally true of civilian and Service patients. In the former the influence of over-anxious and over-sympathetic relatives, in the latter the inclination to exaggerate symptoms in order to evade unpleasant duties, may obscure the clinical picture at the first interview.

Special Investigations

X-rays.—By the time our hypothetical patient comes under neurological observation his skull will almost certainly have been X-rayed, but it is by no means so certain that the report he brings with him will be accurate. Common faults are inadequate pictures, misinterpretation and incomplete description. I suggest that radiologists should agree that when there is question of a fractured skull a standard series of pictures should be taken.

It is equally important that in X-ray reports the extent of the fracture should be described accurately, and with special care in the case of fractures running into, or close to, the accessory air sinuses, and that whenever there is any doubt as to interpretation this should be stated. The distinction between a small linear fracture and a vascular channel is notoriously difficult at times. In such cases the radiologist is perhaps unduly inclined to give the patient the benefit of the doubt, and it is not very uncommon to find a fracture reported when the final verdict decides that none exists.

Examination of the cerebrospinal fluid.—Lumbar puncture very seldom reveals any abnormality of pressure or constituents in the type of case under consideration. It may provoke severe headache in a patient who is on the mend and so impair confidence. It is therefore better omitted from the routine and reserved for the exceptional case in

which there are clinical grounds for suspecting abnormalities of pressure.

Air encephalography.—What has been said about lumbar puncture applies with even more force to air injection, which should be reserved for cases in which there is gross evidence of organic cerebral damage from mental or physical examination. In such cases a lumbar or cisternal encephalogram may provide evidence which is of consider-

able value in pathological interpretation and assessment of prognosis.

Electro-encephalography.—The value of the E.E.G. in post-contusional states has been described so clearly and so recently by Denis Williams (1941) that I shall not recapitulate his findings. In about half the cases showing the chronic post-traumatic state he found an abnormal E.E.G. as compared with a figure of 8% by the same standards in a control group. The E.E.G. must now be regarded as an essential part of the special investigation in any case of severe or moderately severe head injury seen in the later stages. Its value will then be much enhanced if there is a record for comparison taken in the early stages.

Differential Diagnosis

Differential diagnosis in the stage which I am considering is seldom difficult if the

record of the earlier stages is adequate.

As to the distinction between the physiogenic and the psychogenic factors in a given case, they appear in most cases so closely intertwined that to separate them is unnatural. I am thinking, of course, of the case in which there is no doubt that organic cerebral damage has occurred. That a man with a hurt brain should have a disturbed mind is to be expected. It is equally to be expected that this disturbance will affect his capacity for adjustment as a whole. What then follows must depend upon the psychological situations to which adjustment is called for. The disorder of function is related not merely to any set task of the moment, but a continuous series of adjustments. This is why our formal psychiatric tests are of relatively little value in assessing disability. We need to get inside the man as far as possible, looking back into his past and forward into his future. Even so, it is often impossible to measure disability except by putting a man to his old occupation for a continuous period of some weeks and seeing what transpires.

It will be understood from what I have said that I regard the practice of dividing the post-contusional cases into two groups, labelling the one organic and the other functional,

or neurotic, as unprofitable and misleading.

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nto ing hat the nal, For convenience of description I suggest that it would be better to use the ordinary psychiatric headings with slight modification, e.g. Brain Injury with Intellectual Impairment, Brain Injury with Depression (or other affective disorder), Brain Injury with Hysteria, Brain Injury with Psychopathy.

### Treatment

There should be no delay once the examination is completed, in giving explanation and reassurance. In giving this we had best be truthful. We shall then be obliged to admit that headache, dizziness, difficulty in concentration and feelings of nervousness and depression are often slow to disappear; but we can say, at the same time, that symptoms of this kind seldom prevent a man for long from returning to his usual occupation, provided that he is patient and will make the best of things. We can dispel fears of insanity, and it is surprising how common these are. We can, and should, do a great deal more than this, of course, in the way of psychotherapy, which has a place in the treatment of every case of this kind.

The ideal atmosphere for treatment at this stage is that of a convalescent hospital at which there are well-organized departments for occupational therapy, physical exercises and indoor and outdoor games. The daily routine should be planned with suitable spells of compulsory rest in the early stages, and a reasonable allowance of free time. For Service patients the problem of disposal naturally looms large and this has close relation to treatment. Men who are to be invalided should be separated, as soon as the decision is made, from those undergoing rehabilitation for return to duty. When there is a probability that a man's category will have to be reduced, the sooner the decision is made the better, in order that he may know what lies ahead of him.

There is much ground for optimism in the treatment of post-contusional states, especially in young people. We see many cases of complete recovery after a post-traumatic amnesia of many days, or even weeks, but we should be wrong to take these as our standard. If we do so we shall be promising the majority more than they will get, and asking of them more than they can give. The results often are disillusionment and resentment. These two symptoms are often prominent in the post-contusional state and hard to get rid of once they are set. They are symptoms therefore which need to be nipped in the bud. Early and accurate prognosis are indispensable if this is to be done. Ideally we should wish to be able to tell the patient that in so many days, weeks, or months, he will be symptom-free, or fit to return to his occupation; or if there is no such good prospect ahead, to prepare him to restrict his activities and make the best of his disability. In fact, we are, I submit, all too doubtful in many cases of what the future holds, and for this reason the tone of our encouragement is often a little flat, or it may be sharp. Inquiry into the factors which influence the prognosis of brain injury is therefore most desirable. It must be detailed and extensive. Long term follow-up is essential.

We are at present, I think, too much inclined to assess prognosis in terms of those facts which are most easily ascertained. We have learned to discount fracture to a great extent, but there is a tendency to lay too much stress on the presence and duration of traumatic amnesia. It is well known, of course, that a man may suffer a severe localized cerebral injury from a penetrating wound without any loss of consciousness. This is rare in cases of closed head injury, but does occur. A man may, for example, suffer a permanent and totally disabling aphasia from blunt injury without having lost his senses. In a case without focal symptoms, however, the absence of amnesia is generally good ground for a satisfactory prognosis. It is much harder to generalize with regard to the duration of amnesia, when present. In a series of Service patients with closed injuries, the numbers of patients with different durations of post-traumatic amnesia who were invalided or returned to duty have been tabulated. It must be observed that the cases providing this material were a selected group. Most of them had been transferred to a Head Injury Centre because they were doing badly. Moreover, the conditions of duty to which they had to return were exacting as compared with the more flexible conditions of civil life. This, however, for purposes of observation is an advantage, since it may be assumed that the conditions for every patient in the series were comparable, and that the man who relapsed did so because he could not carry the load as well as the others, not because he had to carry a heavier load.

Post traumatic	Number of		II il disposal	Proportion of original number	IV Total	
amnesia	Cases	Duty	Invalided	invalided later	invalided	
Less than 1 hour From 1-24 hours	210 302	81% 78%	19%	4%	23%	
From 1-7 days More than 7 days	216 143	71% 63%	29% 37%	9%	38% 48%	

It is apparent from column II in this table that in the assessment of prognosis in a certain age-group and in relation to fairly well-standardized occupational demands, the duration of the post-traumatic amnesia is of value. The longer the duration of the amnesia, the less likely is it that the patient will attain a degree of recovery which justifies the decision to return him to duty. Column III brings out another point. The figures record the percentage of the total number of cases in each group in which a follow-up showed relapse and subsequent invaliding. They show that of the men who had been judged fit for duty after rehabilitation (which included heavy physical training), a proportion were unable to stand up to the demands of Service life and that liability to relapse, or falsification of a good prognosis, progressively increased with the duration of the amnesia. Putting it another way, in men who have apparently recovered from the effects of their head injury, the longer the duration of the amnesia, the greater is the probability that residual defects of cerebral function will be revealed by the crucial test of return to what is, for the Service patient, a normal mode of living.

Column IV shows the total percentages invalided in each group, including the relapses. This reveals that if the duration of amnesia, without consideration of other factors, were to be taken as the sole criterion of prognosis, the expectation of successful return to duty for those with an amnesia of less than an hour is 77%, as compared with 52% for those

with an amnesia longer than seven days.

From whatever angle these figures are viewed, therefore, the value of the duration of the post-traumatic amnesia as an index of prognosis is apparent. It is, however, equally apparent that the duration of amnesia is not the only factor which counts in prognosis. For example, if we were called upon to give an opinion upon the prospects of return to duty for a man who had recently emerged from a post-traumatic amnesia of ten days' duration, without examining the patient, and without reference to any other details of the case, on the basis of these figures, whichever way we decided the chances of our being right or wrong would be about equal. Taken by itself, therefore, the duration of the amnesia does not carry us very far on the road of prognosis. One patient with an amnesia of two or three weeks may be back at duty within four months of his injury, and succeed; another with an amnesia of less than one hour may not get back to duty at all, or having done so, may fail. If, therefore, we are going to make use of the post-traumatic amnesia as a yardstick by which to measure the severity of the injury in terms of prognosis, we should use it with a good deal of caution, and with a keen eye for all the

other factors which may weigh the balance in one direction or the other.

Success in the treatment of closed head injuries-and I am thinking now especially of success as measured in terms of the shortest possible period of invalidism-has been hindered in the past by the traditional acceptance of fixed rules, such as that which imposed three weeks flat in bed for every patient with loss of consciousness, however brief, or that which necessitated so many weeks' absence from work after a fractured skull-It would be a great pity if, at this stage of our knowledge, we should enslave ourselves to fixed rules based upon the duration of post-traumatic amnesia. I have stated elsewhere (Symonds, 1941) reasons for supposing that the duration of the post-traumatic amnesia is mainly dependent upon a generalized disturbance of cerebral function, which is reversible. A long duration of amnesia, therefore, is compatible with complete—and rapid—recovery after clear consciousness is recovered. Inasmuch, however, as the duration of the amnesia is a measure of the severity of the generalized disturbance, it is also a measure of the severity of the blow. The greater the severity of the blow, the more likely it is to have caused local structural damage with long lasting or permanent effects, in addition to the generalized, reversible disturbance of function. It is to be expected, therefore, that symptoms of coarse cerebral damage will be observed more often after a long amnesia than after a short amnesia. During the period of clouded consciousness the most important of these symptoms, those indicating mental impairment, are masked. Therefore, it is not until some time after the patient has recovered clear consciousness that the extent of the more lasting effects of the injury can be gauged. It follows that examination of the patient, and especially the examination of mental function, after the period of amnesia is over, is a truer guide to prognosis than the duration of the amnesia itself. These views have been confirmed by the impressions gained from the experience of the past two years, though they have yet to be subjected to the analysis of factual data collected from a large series of cases.

Meanwhile I deprecate the use of such a table as that proposed at a recent discussion before this Section (Cairns, 1942) in which the duration of the post-traumatic amnesia is set out in relation to the shortest time in which ability to carry out full work may be expected to return. For example, the first group taken is that in which the post-traumatic amnesia is from five minutes to one hour, the minimum period of disability for full work being stated as four to six weeks. Certain qualifications are made, but there is no mention of symptoms suggesting focal structural damage, which I believe are of greater

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importance than the duration of the amnesia. If the working rule provided by Cairns were followed there would be liability to error in two groups of cases. The first, which is numerically more important, comprises those in which, after a momentary loss of consciousness, there is mild confusion and automatism with amnesia, often for more than five minutes, and not infrequently for more than one hour, and with complete recovery in the course of a few days. I have seen many such cases in civil practice, and have no doubt that many such occur in the Services which are never seen at Head Injury Centres. The second, and smaller group, is represented by the man whose amnesia is of less than five minutes' duration (it may be nil), who suffers prolonged disability, possibly for several months, on account of localized headache, intellectual impairment, or personality change, probably as the effect of localized cerebral contusion. This group of cases Trotter rescued from the dumping ground of traumatic neurasthenia. It would be a retrograde step to put them back there, yet there is danger lest too close an adherence to the rule of the duration of the post-traumatic amnesia may lead to the assumption that disability beyond the limits of this rule must be psychogenic.

I am aware that I have discussed prognosis at some length, whereas it is not included in our title. I make no apology for this, for I believe that many of the symptoms which we have to treat arise from the uncertainty in the patient's mind about whether he will ever get rid of his headaches, or when he will get back to a normal existence. I hope that the material accumulated by the head injury centres in this country will enable us to get rid of some of the uncertainty in our own minds about the answers to these, and other

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Dr. Aubrey Lewis: During the first few weeks after a head injury it will often be necessary to decide on the causes and pathology of the mental condition. That it is mainly exogenous will be concluded when there has been clear evidence of cerebral damage (I suppose that the term "contusion" is not going to be applied unless there is such evidence) and where some "organic" symptoms have followed close upon the injury. Direct visual evidence of cerebral damage, such as the surgeon may have, will of course often not be forthcoming, and the evidence will then be only of disturbed cerebral functions, among which consciousness will be the most important. The signs of a damaged brain, apart from the focal ones revealed by neurological examination, are much the same whatever the lesion: various degrees and combinations of impairment of memory, grasp, orientation, perception, thinking, affect and spontaneity. When an exogenous brain syndrome, following trauma, has been recognized, the question of ætiology has not been disposed of. patient's delirium, for example, may be a straightforward delirium tremens far more dependent on his long-standing alcoholism than on his recent head injury; you can call that differential diagnosis, if you like, but it is better to consider it as ætiology since both the alcoholism and the head injury have probably contributed to it. Differential diagnosis is too prone to insist on absolute verdicts between more or less incompatible claims. are several physical causes to be reckoned with, in acute post-traumatic mental states: alcohol, infections, presenile and senile conditions, cerebral vascular disease, G.P.I., tumours and epilepsy. Besides these diseases, which may occasionally play a large part in causing the acute mental disturbance following head injury, there are constitutional causes predisposing the patient to this or that type of disturbance. His fatuity and euphoria, for example, may be more eloquent of his hypomanic disposition than of a destructive lesion of his brain; his apathy and lack of initiative may be akin to the depression he formerly experienced after a bereavement or an attack of scarlet fever, and may have little to do with his frontal lobes; some patients exhibit schizophrenic syndromes as soon as they have recovered consciousness, others pass by stages through stupor and confusion into schizophrenia. It would be inappropriate to consider here how the catatonic stupor or excitement released by cerebral trauma may be distinguished from the exogenous traumatic syndrome coloured by schizophrenic trends. In either case, however, the previous history of the patient, and especially his personality may be an important guide.

So much for the early conditions, appearing during the first few weeks after injury. There is, of course, no clear distinction between early and late post-traumatic syndromes.

But hitherto I have been considering those developing while the patient is still indisputably suffering from the effects of cerebral damage. If the evidence of damage has been slight, and the period of unconsciousness in particular quite brief, this stage is soon over, though it may be assumed that by a contusion something more than a mild or trifling concussion is meant.

The conditions seen during the later stage can be divided into three classes: (1) the semi-chronic or chronic organic syndrome (usually a Korsakow amnesic one or a dementia); (2) the semi-chronic or chronic insanity, usually a schizophrenia; and (3) that common, dubious, psychopathic condition—the bugbear of the clear-minded doctor and lawyer—post-traumatic neurosis and personality disorder. It includes the "minor contusion syndrome" of Symonds, the "psychasthenia" of Mapother, the "traumatic psychopathic constitution" of Ziehen, and the "post-traumatic personality disorder" of American writers. Uncertainty about it turns mainly on the question: Is it due to structural damage or is it psychogenic? The insistence upon this is understandable, but fallacious; understandable, because the somatic pathology of any disorder is of prime importance, and because so many social issues such as attributability and pension rights depend upon the answer to the question; fallacious because it ignores the real state of affairs at present, and asks us to say "Yes" or "No" to a question often unanswerable in that form.

The question presupposes that exclusively physiogenic and exclusively psychogenic cases can occur, and that every case will be at least predominantly psychogenic or predominantly physiogenic. To substantiate such a view, the criteria of psychogenesis or of physiogenesis must be clear and demonstrable. But they are not. Physical damage to the neuraxis can produce all sorts of mental symptoms, including neuroses and personality disorders: encephalitis lethargica is a convincing example of this obvious truth. The ordinary features of an exogenous mental syndrome may be totally lacking. It is therefore impossible to infer whether a mental syndrome is physiogenic or not by study of the symptoms presented in it. There is nothing characteristic of the syndromes thus produced by certain kinds of structural damage, to enable us even to group them together as of structural origin. Are we then to conclude that a condition is physiogenic whenever we can prove existent cerebral damage? Scarcely, because the brain may have adapted itself, as we know it can, to this lesion, and persisting disturbance of function may not then be attributable any longer directly to the tissue damage. Moreover in a large proportion of the cases in question there is no evidence of existent physical damage to the brain.

It could not be said that we are on safer ground in settling the criteria of psychogenesis. It is notoriously easy to find psychological causes if you look hard enough. You can find them in patients with tumours and disseminated sclerosis and carbon monoxide poisoning and all sorts of organic diseases. The adequacy of the psychological motives to account for the symptoms can be so much a matter of personal opinion—one doctor disagreeing entirely with another doctor—that it is hardly to be thought of as a useful criterion in any dubious case. For rather similar reasons the response to a change in the situation or to some psychological device or treatment can be deceptive and ambiguous: even a dramatic change can be produced, say, by hypnosis in the symptoms of a patient

with disseminated sclerosis.

These arguments might perhaps be dismissed as casuistry since there are cases where no one is in doubt as to the mainly physiogenic or mainly psychogenic nature of a neurotic illness. But it is because of the lack of any unequivocal and agreed criteria of physiogenesis and psychogenesis that we are so often in a dilemma in diagnosing a

patient with a post-contusional neurotic syndrome.

I believe that we have no unequivocal criteria, no final distinction, between physiogenic and psychogenic because the search implies a dualism which is not there. Focal brain damage may produce characteristic disturbances of function, usually seen as neurological signs: gross widespread brain damage may produce disturbances of function, recognizable and characteristic of exogenous mental syndromes (though even these may be closely mimicked by affective disorders and by schizophrenia); but less acute and coarse disturbance may produce nothing that could not also be produced in a man with an intact brain, exposed to stresses of another sort. The patient, as a wholly integrated human being, deals with what happens to him in ways that are determined by his hereditary endowment and previous experiences: if he sustains an injury to his head, his behaviour at any subsequent stage cannot be thought of as simply the sum of his normal functions plus the reduced or altered functions due to this destructive lesion. His behaviour at every stage is a reaction to an existing situation in which his symptoms at the time, his financial, social, domestic and other difficulties are elements; the form of this reaction will obviously be determined by what has happened to him up to now. It is therefore in principle a plastic response, not a fixed one. The physician who concentrates on

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the cerebral damage is treating behaviour as though it were a neurological sign, constant and always referable to some local place of origin. If at the other extreme he concentrates on the environmental factors and the psychological reaction, he may be ignoring the most important aspect of that recent happening which has left its mark on the patient's brain, creating perhaps fairly rigid symptoms (like diplopia, dyspada) or even a headache) and

making a pattern of behaviour from which he can now hardly depart. If such a point of view is held, there is no sense in supposing that one must always decide whether late post-contusional syndrome is physiogenic or psychogenic. will always be some of the latter in the causation, there may be quite a lot of the former. If one can appraise the physiogenic residue by neurological examination, or electroencephalography or other special device, of course one will do so. Even if it is extensive one will not treat its disturbing effects on function as irremediable; any more than one wants, after appraising the extensive psychogenic side, to psychoanalyse it or regard it as original sin. Before speaking of treatment, however, there is more to be said about diagnosis. Some of the symptoms may be obviously hysterical; sometimes the whole syndrome cries out hysteria. Even so it cannot safely be concluded that there was no structural damage to set these works going: there may have been. The headache, giddiness, lassitude, forgetfulness, insomnia, may differ in time of occurrence, degree and other characters from these symptoms as met with in the earlier stages of post-contusional disorder when the symptoms may be assumed to be chiefly due to structural damage. It would be misleading to infer that they are now, therefore, wholly a motivated construct; they may be hypochondriacal exaggeration of existing physiogenic symptoms. No one would deny that a person free from detectable neurotic predisposition may, after a head injury, become irritable, easily tired mentally and physically, depressive and apathetic, because of cerebral damage. But for one such easy case there are half a dozen or more, difficult ones, by no means clear-cut, and even in this easy case a little carelessness in the handling may result in prolonging or fixing the disability. Such carelessness arises from preoccupation with the antimony-physiogenic or psychogenic-which I have been deprecating for clinical purposes. Research into the problem is a rather different matter

Assessment of physiogenic damage.—Goldstein and other workers have tried for a long time to use psychological tests to detect physiogenic damage to the brain. Pfeiffer's description of a long array of psychological tests occupied fifty pages of his monograph on mental disturbances after brain injuries in war, and in the twenty years since that was written, a great deal more has been done. It would therefore be impossible to review the matter in any detail. The bulk of recent work has been much influenced by Goldstein who emphasizes the disturbance in "categorical", i.e. conceptual thinking. Tests for conceptual thinking do not, however, cover the available methods. Babcock devised a method of detecting and measuring deterioration which relies on a discrepancy between present capacity and presumptive previous capacity estimated by a vocabulary test. Changes in personality due to head injury are referred by Goldstein to the conceptual difficulties, but may be studied in their own right, as by the Rorschach procedure. Disturbances of memory have been investigated, as in Zangwill's study of the Korsakow state.

The work done in this field by E. L. Trist and his co-workers at Mill Hill has taken account of most of these methods, and attempted to combine a number of different tests in a set that could be administered in a short time, say, half an hour, and would be clinically useful. No single test suffices to pick up deterioration because it is not a matter of independent functions such as memory, attention or intelligence which may each The tests used were modifications of the Shipley vocabulary, be separately affected. Dworetzki pictures, Wechsler's similarities, a sorting test using shapes, Weigl's colourform sorting test, and Kohs blocks: other tests such as Vigotsky blocks, Bolles' and Halstead's sorting methods were also examined. So long as the investigation was limited to persons with known cerebral damage, all was well: tests revealed the expected dis-This was true of the group of treated general paralytics who were selected as the most satisfactory analogue to the late post-contusional patient; the cerebral damage in them being certain but non-progressive, and often no longer clinically detectable. But when the same set of tests was administered to a group of neurotic subjects in whom there was no reason to suspect any structural damage, some of them behaved very much as did some of the patients with G.P.I.: the same was true of "normal" subjects tested, though this was less evident if one took the set of tests as a whole than if one looked at individual tests. To put a complicated matter briefly, it has become evident that when the diagnosis of organic damage is clinically doubtful, psychological tests cannot as yet be relied on to supply an unequivocal answer; there is no psychological Wassermann reaction here, no skin test, X-ray or blood picture to settle the vexed question. Because the psychological tests do not settle the question of cerebral damage they are not to be thought useless. There are many cases in which the results of these tests are such as could only be yielded by cerebral disease; and in any case, besides the diagnostic issue it is often necessary to know exactly what functions are impaired and to what degree, so that suitable work and treatment may be offered the patient, and the rate of his improvement measured: for these purposes the psychological tests mentioned and others of a more special aptitude-measuring kind are indispensable. These tests, in short, are in the same relation to our routine clinical investigation of memory, grasp, &c., as the standardized intelligence test is to our impression of a man's intelligence: precautions are necessary in interpreting the standardized measure just as in interpreting our rough clinical findings. The validated set of tests, with its items systematically considered and checked, is a more precise instrument, and its findings on different occasions can safely be compared so that one

can tell if the patient is improving in particular respects.

There are many other psychological tests, less concerned with the fundamental question of deterioration, that have been used in cases of brain injury. The most interesting and popular of these is the Rorschach inkblot—which is chiefly a personality test. The elaborate methods of interpretation and the obscure terminology of this test make it a rather esoteric affair, and I cannot pretend to be more than a proselyte at the outer gate. Piotrowski has laid down canons of diagnosis for organic cerebral disease by this method, and Harrower-Ericksen in Montreal has made easily understandable contributions to the same matter. It has been plain, however, in the work done by Miss Harvey, Trist and others at Mill Hill, as well as in Ross's paper, that what had been regarded as organic types of response to the test can occur in insane persons, hysterics and other psychopaths, and normal people of poor intelligence, without any organic cerebral affection. The position is, again, that these types of response occur commonly in organic disease but they cannot in a doubtful case, where there are psychiatric symptoms, be used as diagnostically decisive. For some aspects of the patient's personality, the Rorschach findings are illuminating, whatever the cerebral condition.

## Survey of a Series of Cases

I have lately made a survey of a series of post-contusional states admitted to a neurosis centre. There were 64 patients in the series, all men, nine of them civilians and the rest soldiers. The form of the clinical syndrome displayed was diagnosed in the usual psychiatric terms, and a group of 64 patients taken for comparison from the other neurotic patients in the hospital. The selection of these was at random except that they were of the same sex, included the same number of civilians, and exhibited the clinical syndromes in the same proportion, as did the head injury cases. Thus there were 16 patients with conversion hysteria in each group, 2 patients with hysterical amnesia, 6 with a severe acute anxiety state, 14 with a chronic anxiety state, and so on. The number of cases, 64, may seem small, but the number of attributes in respect of which they were compared was nearly 150, and covered practically all the main points of psychiatric interest in each case. The main items are shown in Table I.

The points at which the two groups differed significantly (i.e. statistically so) were remarkably few. More men in the control group had been discharged Category E, had as adults shown signs of predisposition to mental disturbance, had been unsociable, weak and dependent, lacking in initiative, over-anxious, hypochondriacal or obsessional. More of them complained of pain (apart from headache) and anxiety symptoms; whereas the head injury cases included, as would be expected, more people who had been of stable, well-organized personality before their illness, and severe headache, fainting and irritability were commoner among them. But the differences in these respects were only on the margin of statistical significance, and it was evident that the head injury series was made up of very much the same sort of people (in family and personal history, intelligence, symptoms, response to treatment, and outcome) as the non-organic group.

It is clear that these post-contusional cases had been sent to a neurosis centre because some doctor thought they were of a particular type: they are not necessarily representative of the minor contusional syndrome, they will include a perhaps unduly high proportion of those whom the doctors referring them judge to have recovered from all physical effects of their trauma. They were, however, very good examples of the syndrome, clinically, and many of them had had very severe head injuries; where they differed from the average case, I think, was in the length of time that had elapsed since the injury, so that features of chronicity and habituation were prominent. However, the striking thing is that the long-standing, relatively intractable post-contusional syndrome is apt to occur in much the same person as develops a psychiatric syndrome in other circumstances without any brain injury at all.

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				15		39
				24	Delinquent 2	4
				12	Inert, without Initiative 11	23
41 and over			. 6	8		17
Service Patients Only						29
Service Occupation-	Skilled		12	15		20
21.00			- 0	3	77	20
Category on Enlistme	mr_Not A	0.00	-	8	1 1	23
Category on Discharg				25		80
		***	2.5	9		20
			0.0	10		20
			4.4	10	History of Present Illness	
Civilian Occupation						15
Professional or Admir	nistrative		6	11	Exposure to Enemy Attack:	
Skilled				10	Severe 20	8
					Medium 11 1	14
Earnings					Symptoms	
			25	30	Somatic Anxiety 25 1	28
£7 and Over		0.00	5	2		24
Unemployment					" —Severe 25	6
Maria			PP	10		21
				17		28
Little Work History : De-g	noded or um	dula		8.0		18
	raded or un	iguiy		5		14
frequent changes Duration of Stay—A	More then	*****		43		3
			- 0	16	Pain 7 2	- 95
months				10	Severe Tremor 3	6
Family History					Stammer 5	8
m 4 1			7	14	Enuresis 2	2
2.5		0.00	00	24	Sexual Anomalies 2	5
Actions, etc.	***		40.00	20.00	Anxiety-Mild 21 1	15
Personal History					Moderate 16 2	85
Upbringing other than	hy Parent		1	5	—Severe 8	8
Upbringing Unsatisfa			9	15	Depression-Mild 28 2	24
Education :				40		16
Elementary-Poor			12	18	—Severe 4	1
Secondary or Cents			400	8		11
Higher			2	1		10
Sex Anomalies			6	12		12
Social Activity-Muc	h			5		17
" " —Little				43		4
						1
Past Physical Health					Hysterical:	_
Medium			18	27		3
Bad			2	4	Sensory 16 1	12
			1	0		1
Previous Organic Disc	ase of Ner	VOU8				4
System			1	3		4
Previous Organic Diseas	e Elsewher	e	9	8	continued continued in the	8
					Treatment	2
Frevious Mental Health						2
Symptoms in Childho	od		17	17		4
Predisposed in Adult	Life		18	28	" Separation, &c 24 3	12
Definite-Illness			10	6	Treatment	
Previously Treated in .	Mental Hor	pital	1	0		14
Out-Patient Departme	ent		0	2		5
Private Doctor			12	12	Narcosis or Insulin 1	2
		100				-

### Incidence of Head Injury in the Psychopathic Personality

This raises a further question—are people of psychopathic predisposition more likely to sustain a head injury than others? If gunshot wounds were the common form of head injury, the answer would certainly be "No". But while accidents on the roads remain so frequently responsible, a more careful answer is needed. I suppose everyone reading through a series of head injury records is struck by the way some of these patients seem to have been dogged by a malicious fate so that they have had two, three or even four head injuries in the course of five or ten years. It is less likely that one head injury predisposes you to have another than that some people are particularly prone to accidents because of some slowness of reaction in an emergency, defect of judgment, or other trait. Farmer and Chambers, in their industrial Health Research Board Report, No. 84, have shown convincingly that accident proneness is an important factor in motor drivers, leading to repeated accidents, and that experience in driving does not avail to alter the differences between those specially prone and others: moreover they found that certain psychological tests were done badly by those with a high average accident rate. It is not unlikely, therefore, that among those who sustain head injuries in road accidents there will be a higher than average proportion of predisposed, and perhaps neurotically unstable persons. This is not to deny that many who sustain head injuries have previously been well-adjusted, healthy people. It emphasizes, however, the need for looking into the previous personality of the man with a post-contusional syndrome and indeed paying at least as much attention to this as to the extent and persistence of cerebral damage.

The situation arising out of the accident has also to be considered, if the true ends of diagnosis are to be served, for this may be the most potent of all the causes of the postcontusional syndrome. I said earlier that the patient has to react at any stage to the existing situation. I would like to stress that this situation cannot be reduced to a few salient features, any more than personality and behaviour can. To single out the compensation side of it, or the chance it offers of escaping with honour from disagreeable duty, is to overlook a great deal. Often the desire to obtain money is construed by the doctor as the main motive in the patient's continued illness when cerebral damage no longer suffices to account for his symptoms. By no means all the non-physiogenic postcontusional syndromes are hysterical-depression and anxiety are conspicuous: nor are hysterics who claim compensation actuated only by this in the production of symptoms. Loss of employment, insecurity, and many other forms of social pressure are at work, not to speak of the hypochondriacal, anxious and other latent trends now set in motion by the severe threat to his life, his reason or his health which the patient believes he has sustained. His symptoms themselves form part of the situation he must cope with. We can see this easily enough in a man with dysphasia or squint—he obviously has to adapt to the disability-but we tend to overlook it when his symptoms are more of the psychological kind.

So much for the diagnosis of these common and often difficult cases—not so much diagnosis, I suggest, as appraisal of multiple causes, the doctor taking care neither to hunt the snark of physiogenesis to death, nor perfervidly to track the red herring of moral obliquity (" gold digging", " scrimshanking") to its lair.

### Treatment

Treatment is more preventive than actual. The damage done by ill-advised treatment in some of these men could not be put right by a demigod. I would mention only what seem the essentials of preventive treatment: (1) To decide early what plan to adopt and, as far as possible, to adhere to it. (2) To let the patient know, as soon as may be, that he will, or will not, have such and such residual disability which will clear up, and that he need fear only so much incapacity, or none at all eventually. (3) To see that misguided relatives or friends do not tell him a highly coloured story of the accident, but that it is explained to him soberly and with due allowance for his amnesia and other symptoms. (4) Not to prolong the period of rest and inactivity, but to institute early some mild work or interests, no more exacting than his state warrants, and gradually to increase both the opportunity for activities and the incentive, taking care on the other hand to avoid overtaxing him to the point where frustration and "catastrophe reaction" could lead to an exaggerated concern over his disability. (5) To help him in any financial, legal or domestic embarrassments to which the accident has conduced: a skilled social worker is here most valuable. (6) To do everything possible to bring the phase of special examinations to an end, except in so far as they are necessary for assessing progress or deciding on special methods of treatment or disposal. I do not here refer to regular definite investigations (whether physiological like the E.E.G. or psychological, like the set of tests mentioned earlier) but to the repetition of X-rays, lumbar punctures, and other procedures which give the patient the impression that the doctors are not sure about him, that they cannot decide whether his brain, or his mind, is seriously damaged; worst of all is it when he passes from hospital to hospital, each repeating the investigations and perhaps reversing the diagnosis or the treatment advised at the previous one. These and other precepts are obvious enough, but they have often been flouted, heedlessly and harmfully, by the time the patient reaches the neurosis centre, at any rate, and I suppose head injury centres could tell the same tale. Much of this over-investigation must arise as I have said from mistaken concern over the question whether the illness is physiogenic or psychogenic-a question that is often the parent of muddle, though intended to bring light and clarity.

### Rehabilitation

This subject was discussed three months ago before the Section. A few points, however, call for brief reference. It was said in that discussion that rehabilitation will include occupation (diversional, constructive, and useful to the hospital), physiotherapy, and intellectual and recreational pursuits. There is no mention in this list of any special care for the patient's individual psychological problems. It is obvious that work and physical activities, games and reading all exert some psychological effect, that in this indeed their chief efficacy may lie; but the patient is an individual and unless his private difficulties and attitudes are given sufficient attention, the rest of the valuable routine may not avail to make him well. At different periods after his injury the importance of these psychological problems varies; the later it is, the more they control the illness and

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should determine its treatment. More explicitly, one might say that after severe or moderate cerebral contusion, for a while the patient reacts as an average human being whose brain has been damaged at certain points, rather than as a particular human being who is in a particular fix. Later on the individual difficulties and reactions overshadow the general, more or less common, pattern of disturbed cerebral function. But what I said earlier indicates that this needs qualification, and that the influence of the patient's constitution, his past, and his present circumstances must be reckoned with from the outset. It is not possible to reckon with them to good purpose unless one has knowledge of them. This knowledge, which may be obtained sufficiently from a relative of the patient, is in many cases all that is necessary and practicable in the early stages after his injury, and may be all that is necessary throughout; but there are some in the early stages for whom it is not enough, and it is hardly ever enough in those later stages when the "minor contusional syndrome" has asserted itself ominously.

In other words, you are unlikely to succeed in getting rid of the patient's symptoms if you can only surmise what factors are producing these symptoms; and even if your surmise is correct you cannot always deal with these factors by environmental adjust-

ments (through the social worker and the relatives) or by indirect methods only such as those listed under work, recreation and physiotherapy. Direct psychological treatment is called for-not, of course, invariably. I think there is a good deal of misunderstanding about this. Psychological treatment of any sort is good or bad according to its appropriateness in the particular case and the skill with which it is conducted; harmful probing is, of course, unskilful, as superficial dabbing can be, or crude ploughing and plugging. Psychological treatment will not consist in a choice between the extremes—psychoanalysis or a casual chat. As Colonel Cairns put it in that discussion "no attempts at rehabilitation are likely to be successful unless the patient's anxieties and fears are assuaged and unless he is helped through the phases of depression and the other disturbances of feeling that so often beset him during recovery from head injury". These affective disturbances may turn on responsibility for the accident in which others were injured. I lately saw an Army dispatch rider with an obstinate post-contusional syndrome including pronounced hysterical features in whom it required much finesse and persistence in delicate inquiry, before one learnt that he was in great financial difficulties, that these arose out of his attempt to contribute from his scanty Army pay to the support of the orphan of a man on another motor bicycle killed in the accident in which the patient as driver had had his head injured, and that this in turn was linked up with the censure pronounced on him for the accident by the Army authorities, which he considered unjust-they had degraded him-so that he had a strong hatred of his Army superiors and what they stood for. All this tangle had to be cleared up before he could improve. Some of it was cleared up by simple and obvious measures, some only by addressing oneself to the sources of his guilt, depression and resentment. I am not suggesting that in most post-traumatic syndromes one needs to behave as though the patient was one's oyster, but that it is equally senseless to assume he is a clam. events, oyster or clam, he will be better for tactful discussion of "what is on his mind"; this will vary so much from patient to patient that general inferences, e.g. about the effects of industrial injuries and the Workmen's Compensation Act can have only partial validity for any individual. To avoid misunderstanding, I should add that I believe social factors to be more important than individual propensities in keeping these residual neuroses going-Dr. Russell Brain's figures illustrated this-and that social adjustment, like social measures of prevention, is the essential preliminary to any treatment and itself a more effective means of treatment than psychotherapy alone can be; but psychotherapy, however brief and simple, or however recondite, should never be conducted as a thing apart from social adjustment, occupation, and the other features now recognized to be indispensable for restoring, as for maintaining mental health. The trained psychiatric social worker is often the person who does most, by direct action, to bring about the patient's recovery from a post-contusional syndrome; but, for this, she needs the guidance of the doctor in touch with the patient's emotional and private problems, and the doctor will not be able to give it who relies solely on a well-ordered, progressively adjusted hospital routine of physiotherapy, occupation and other pursuits to do everything for the patient.

Occupation.—Here too the ground was so admirably covered in the previous discussion that there is no need for restatement. I would only stress that it is profitless to let a man do trivial or absurdly easy work at a stage of his illness when neither intellectual nor affective disturbance prevents him doing something more like the jobs of ordinary life. Occupational therapists sometimes allow the principles suitable for treatment of inert melancholics and semi-stuporose or preoccupied schizophrenics to operate in a different type of illness, so that it is thought a triumph if the post-traumatic patient labours dully and steadily at some dreary repetitive job, or now and again tackles in spurts a task well below his actual powers. The patient is thought to be doing excellently when he applies himself assiduously to painting butterflies on glass or disfiguring wood with poker work mottoes. Many men with late post-contusional symptoms are content to loiter along in these pointless activities, which are as demoralizing as idleness. It is necessary at all stages to have the man doing something worth while; not of course flying too high and becoming upset or dispirited at failure, but not, on the other hand, accepting resignedly a low level of work, and aiming only at what would be exclusively leisure pursuits for him, e.g. rugmaking or raffia work. What I am advocating was tersely put by Dr. Brain when he said "occupational therapy should merge into therapeutic occupation"—but in some hospitals the rule that any occupation is better than no occupation

seems still to be the high-water mark of aspiration.

There is no need to discuss at length the question of physiotherapy or of treatment of special disabilities such as dysphasia and epilepsy. As for the "intellectual and recreational pursuits", there is much to be said for making these unobtrusively part of the therapeutic plan. It would, of course, be foolish to tell the patient what he is to read, and to try to control every detail of his day; but if he is to have, let us say, as a soldier, some educational lectures while in hospital, let these have a bearing on real problems, stimulating his interest, but also providing incentives to counteract those which are perpetuating his symptoms. To illustrate this from actual experience would take too much time. There is, however, one still experimental instance of this which shows how education as commonly conceived and education as part of the psychological treatment can be combined: the doctor collects his patients in a group, talks to them a little about some familiar difficulty or misconception that often crops up when he is examining them alone or inquiring about their notion of their illness, and then invites them to ask questions. By this means prejudices and wrong attitudes can be to some extent corrected and the doctor's time economized. One of my colleagues, Dr. Jones, has used this method as an adjunct to treatment of a rather similar group (patients with cardio-respiratory neuroses) and has found it useful and economical. None of these methods is sufficient by itself.

The "demoralization", or psychopathic change in personality, that may follow brain injury, especially in children, is a more difficult business, though at bottom it is the same problem. I cannot say that I have seen outstanding success in the treatment of genuine instances of this; spurious instances are of course common and may do well. It is like the post-encephalitic behaviour disorders: you can palliate by training, but that

is all.

A few words are necessary about the later forms of post-traumatic insanity. They have an incidence of nineteen per hundred thousand of the male population in the corresponding ages. The rate rises from 10 in the 20-29 age-group, to 16 in the 30-39 group, 20 in the 40-49 group, and 25 in the 50-59, 60-69 groups. This increased incidence as age advances cannot be accounted for by an increase in accidents sustained, but must be construed as another instance of how the ageing process is itself, with its reduced functions and loss of resilience, a very prominent cause of these traumatic psychoses. In short it is more an involutional or presentle disorder here than a traumatic one, and the age distribution very similar to that of presenile and other degenerative organic psychoses. Mayer-Gross and Feuchtwanger have dealt very fully with a series of posttraumatic schizophrenias, showing how diverse the factors and course can be. persistent amnesia or Korsakow states and dementias are seldom uncomplicated by alcoholism, atheroma, senile or other somatic disease. It will depend on these other factors-constitutional or morbid-and not upon the injury itself whether the psychosis follows hard upon the accident or there is an intervening period of apparent recovery. This explains I think Mapother's observation that where schizophrenia or a paranoid syndrome supervenes after an interval of normality, the prognosis is worse.

The late post-contusional states are an exemplar of what social and preventive medicine means in the neuro-psychiatric field. The best the doctor can do may fall short because adverse genetic and social forces are at work which he cannot remove, and the effects of which he can only lessen. The least of his obstacles will often be the residual physical damage, and here it is therapeutically and clinically better to look to what is intact or reparable, to the undamaged tissues and the unimpaired and compensating functions, rather than to allow the irremediable structural damage to set a limit in advance to what

may be worked for or attained.

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## Section of Medicine

President-Geoffrey Marshall, O.B.E., M.D.

[May 26, 1942]

## DISCUSSION ON MINERAL AND VITAMIN REQUIREMENTS IN RELATION TO WAR-TIME DIETARY

Dr. R. A. McCance and Dr. E. M. Widdowson: The diet of this country has been considerably modified by the war, but our nett requirements for the various dietary essentials have not been altered. To maintain ourselves in perfect health we have to absorb just as much calcium, phosphorus and other mineral elements as we had to in 1939. Nevertheless, most of us are eating foods to-day which never graced our tables in the piping days of peace. There has, moreover, been an alteration in the way in which foodstuffs are allocated. Now there is a system of planned food distribution, and the diets of rich and poor are tending to conform more and more to a common pattern. The milk which had begun to find its way in large quantities into the milk-bars has been diverted from them to provide all school children, rich and poor alike, with an extra third of a pint a day. It is therefore necessary to ask ourselves whether these changes in supply and distribution have materially affected our intake of minerals.

From individual dietary surveys carried out before the war, it has been calculated that the present rations of milk and cheese provide men, women and children with as much calcium as they were in the habit of obtaining from those two foods before the war. People are, moreover, probably eating more bread and potatoes to make up for the shortage of fats and sugar, and there is, therefore, no reason to suppose that calcium intakes have appreciably decreased provided that individuals are taking the whole of their rations. The same conclusion may be drawn about iron. The iron gained by the change from white to national wheatmeal bread fully compensates for the iron lost because of the restriction of meat.

The question as to whether these two minerals are absorbed as readily from a war-time as they were from a peace-time diet must now be considered. During the first five months of the war McCance and Widdowson (1941) carried out an experimental study of rationing, and the results suggested that calcium and magnesium were much less freely absorbed from the experimental than they had been from the pre-war diets. Although most foods in the experimental diet were severely restricted, potatoes and bread, made from 92% extraction flour, were allowed in unlimited quantities. Metabolism experiments were next carried out on eight subjects over a period of nine months, and the effects of white and brown bread on mineral absorption were compared (McCance and Widdowson, 1942a, b; Widdowson and McCance, 1942). Forty to fifty per cent. of the calories in these experimental diets came from the cereal undergoing investigation. It was found that the subjects, each and all, absorbed calcium and magnesium very much better from the white than the brown bread diets. Iron was also better absorbed. Brown bread evidently interfered in some way with mineral absorption. The first explanation suggested for these results was the laxative action of the brown bread, which was sufficient to increase the weight of the stools by two to three times. The second explanation was that the phytic acid in brown bread might have precipitated the calcium and the iron in the intestine and so prevented their absorption. To understand why phytic acid was considered as the noxious agent, it is necessary to go back to the work which was done by Mellanby soon after the conclusion of the last war. Mellanby stressed at that time that cereal diets tended to promote rickets in growing puppies and that while brown flour was worse, in this respect, than white, oatmeal was the worst of all. At that time Mellanby did not succeed in isolating the rachitogenic factor, which he referred to tentatively as a toxamine. It was not until 1934 that Bruce and Callow, working with rats, suggested that the toxamine might be inositol hexaphosphoric acid, a compound already well known for some twenty years, and present in quite large amounts in the outer parts of the cereal grains. Its rachitogenic action was attributed to the fact that its phosphorus was not so freely utilized as inorganic phosphorus. But while admittedly rickets in the rat is generally brought about by phosphorus deficiency, the disease in dogs and men is due to a failure to absorb enough calcium. Nevertheless, since inositol hexaphosphoric acid has very insoluble calcium, magnesium and iron salts, it was evident that it might precipitate these metals in the intestine and so promote rickets by preventing calcium absorption. In 1939, Harrison and Mellanby showed that the addition of sodium phytate to puppies' diets did in fact lead to rickets. No one, however, had shown directly that phytic acid affected

the absorption of calcium, and no previous experiments had been done on man. Some commercial phytin was therefore purchased, and converted to sodium phytate, and this was added to the dough in the preparation of white bread so that the bread contained as much phytic acid as the brown bread previously investigated. Metabolism experiments were then carried out as before, on diets in which this bread contributed 40% to 50% of the total calories. Absorptions of calcium and magnesium were depressed even more than they had been on the brown bread diets, and some subjects excreted more calcium in the fæces than they took in the food. Phytic acid was therefore definitely

incriminated as the noxious agent in brown bread.

Metabolism experiments showed that vitamin D in physiological doses did little or othing to improve the absorption of calcium by adults. The addition of enough cal nothing to improve the absorption of calcium by adults. carbonate to the bread, however, effectively precipitated all the phytic acid and so ...it the calcium in the remainder of the diet available for absorption. This was the cheapest and simplest way of correcting the bad effects of brown bread upon the absorption of calcium. Fortification of the food would be the only way to cope with an iron deficiency due to phytic acid. Recently it has been found possible to study the absorption of calcium from a "dephytinized" bread. It was found impracticable to "dephytinize" wholemeal flour and to retain its palatable properties. Bran, however, could be dephytinized enzymatically, and the product has been used to reconstitute a flour with all the laxative properties of brown flour but containing no phytic acid. Metabolism experiments have been carried out with bread made from this flour and these experiments have clearly shown that although the hydrolysis of the phytic acid in brown bread does improve the absorption of calcium, it does not make the absorption as good as it is from white bread unless the inorganic phosphates which are formed by the hydrolysis of phytic acid are also removed. This "dephytinizing" process is quite impracticable on a commercial scale for the whole country, but small quantities of patent foods for children or invalids could undoubtedly be produced.

The Government has now introduced a flour containing 85% of the original wheat, 'This will bake a loaf with properties intermediate between those of white bread and bread

made from 92% extraction flour.

There is evidence that diets tended to be short of calcium before the war. They may or may not contain as much calcium to-day, but what they do contain is probably not so well absorbed. It is suggested therefore that war-time bread should be fortified with

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Professor R. A. Peters said in extension of Dr. McCance's remarks about the need for fortification of 85% extraction flour with Ca, and in view of the considerable disturbance in the Press about the addition of calcium carbonate, it was worth recording that for the last thirteen months he and his family (four to six persons) had lived on home-baked 85% wheatmeal bread to which an addition of CaCO<sub>3</sub> (in the form of creta preparata B.P.) had been made to the maximum amount recommended of 14 oz. per 280 lb. flour, or about 0.5 g. Ca per 1 lb. bread. As would be expected, not only had no ill-effects whatever been found, but health had been excellent. In addition radiograms (exhibited) of the eldest member of 53, by Dr. Kemp of the Radcliffe Infirmary, showed no evidence of stone in the kidney or even of any calcification of the femoral artery. Though this was evidence from only one family, it did nevertheless show that for over thirteen months it was possible for a subject of this age to live on the small chalk addition without harm, and it could be produced as evidence against the critics.

Dr. Leslie Harris: Partial deficiencies.—My own investigations during the war have been concerned with tests on groups of people to determine their levels of nutrition in various specific dietary essentials. The object has been to ascertain whether their nutritional status has deteriorated or not as a result of the war-in other words whether they are up to or below given standards of nutritional adequacy, and if below such

standards to measure quantitatively how much below.

The saturation test as a quantitative index.—One method which I have particularly used is the so-called "saturation test", applied for example to vitamin C (although equally applicable to vitamin B,, or to the P.P. factor, &c.). This test enables us to express on a quantitative scale the degree of the deficit: i.e. just how far below the accepted standard of intake the subject has sunk.

The reality of partial deficiencies.—A fundamental issue has to be faced at the start. There are still those who say that scurvy is not much seen to-day, and that beri-beri is almost unknown in England; so that there is no need to determine levels of nutrition. ome

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The answer of course is that it is now possible to demonstrate conclusively that ill-effects do arise from partial deficiencies—or sub-clinical deficiencies would perhaps be the better Much of the evidence of the reality of sub-clinical deficiencies is quite recent-

some of the most striking is only a few months, or even weeks, old.

The evidence for sub-clinical deficiencies: general.—The work to which I refer relates especially to the specific effects of partial deficiencies of particular vitamins. Sub-clinical deficiency of a more general type was well recognized before the war. The classical work of this type was that by Corry Mann; children having extra milk acquired a better state of nutrition than the supposed "normals", as shown by their improved gains in weight and height, by increased high spirits (naughtiness), glossier hair, better finger nails, &c. The same conclusion, that is that the average is frequently not the normal, has been proved repeatedly by similar trials all over the world: whether by the supply of extra milk, by the provision of Oslo breakfasts, by the beneficial results of supplementary feeding during maternity, and perhaps most strikingly by the demonstration that the wide gap between social groups (physique, morbidity) could be narrowed or bridged by equalizing It is important to recognize that in such trials the evidence consists of the feeding statistical differences in the groups as a whole; there is not necessarily any obvious improvement which can be detected in each individual on superficial clinical examination.

Effects of undernutrition in specific factors.—Turning to specific dietary essentials, an excellent example of a sub-clinical deficiency is seen in anæmia. Helen Mackay proved that a large proportion of young working-class children and mothers had a moderate degree of anamia-so moderate in fact that it would usually escape notice at medical inspection. Thus the first reaction of the clinician tended to be: "if the child looks healthy and has no evidence of suffering any disability therefrom, surely such a degree of anemia must be 'normal' or 'physiological' or of no consequence." But what Mackay proved was that the provision of extra iron as well as raising the hæmoglobin levels reduced the morbidity rates in the group—there was therefore a true sub-clinical deficiency.

The effects of sub-clinical deficiencies of vitamins may be instanced by consideration of two of them, vitamin B<sub>1</sub> and vitamin C. The specific results of mild hypovitaminosis as first observed in experimental animals agree very well with those which can be detected in human subjects and indeed have furnished valuable clues as to what to expect.

Sub-clinical deficiency of vitamin B, .—In young animals, growth is sub-optimal in the absence of sufficient vitamin B,. A relatively small dose of vitamin B, will prevent symptoms of beri-beri; a somewhat larger dose will do no more than merely maintain constant weight; a still larger dose will procure mediocre gains in weight; and increasing doses can still be shown to have some appreciable effect in further improving the weightgains up to quite high levels of intake-although to all intents and purposes the animal appears normal on inspection without such increased intakes. Three well-defined specific effects of "sub-clinical deficiency" of vitamin B, in animals are (1) sub-maximal growth rates, (2) gastro-intestinal hypotonia, (3) a latent metabolic defect (in carbohydrate metabolism). There is now enough knowledge available to make it clear that the same three phenomena are seen in man. (1) From America and Canada we have evidence, in numerous publications, that babies and children given extra vitamin B<sub>1</sub> improved their weight gains from "average" to a truer "normal". (2) The weight of evidence supports the contention that constipation was lessened in those groups of children having the additional vitamin B<sub>1</sub>. (3) Finally, my own work and that of my colleagues has proved that tests for the latent defect in carbohydrate metabolism may indicate low levels of

intake in man even when there are no symptoms of the more advanced deficiency.

Sub-clinical deficiency of vitamin C.—In young guinea-pigs an intake of vitamin C sufficient to prevent scurvy or obvious illness is not necessarily sufficient-

(1) to promote maximal gains in weight.

(2) to permit adequate formation of new tissues—e.g. (a) in production of bones and teeth and (b) in regeneration and the healing of wounds,

(3) to promote fullest resistance to infection.

As an instance of the third factor my colleague Dr. Kodicek and Dr. P. D. S. Murray have found that guinea-pigs given experimental fractures develop infections at the site of the fracture when the diet is partially deficient in vitamin C, i.e. containing enough to prevent scurvy but less than the true optimum. Recent observations prove that the same three "sub-clinical" effects can be detected in man, viz. sub-optimal growth, poor healing of wounds and diminished resistance to infection.

Likelihood of partial deficiency of vitamin C in war-time.—The League of Nations' standard for the requirement is 30 mg. per day. Does it matter if people receive less than this amount, provided they do not develop scurvy, or provided they do not receive less than the amount recognized as adequate to prevent scurvy (about 15 mg. per day)? Let

us weigh up the arguments for and against.

(a) Con.—Zilva (Biochem. J., 1941, 35, 1240) says: "As far as the civilian population of this country, leading a normal life, is concerned, the natural supply of vitamin C during the greater part of the year is so superabundant that, even allowing the widest margin for destruction in the cooking and the preparation of the food, the intake is more than adequate to supply the vitamin C requirements." Fox and his colleagues (Brit. M. J., 1940 (ii), 143) found that among miners receiving 12 to 25 mg. of ascorbic acid daily only 12 out of a total of 950 developed scurvy; one man only in a group of 950 labourers receiving 40 mg. of added vitamin C developed symptoms suggestive of mild scurvy—the general health of the two groups was not otherwise different. In the experiment of Crandon, in which a human volunteer was given scurvy experimentally, the deleterious effect on wound healing was not apparent until a relatively late stage in the development of deficiency and the subject did not become infected (Crandon et al., New

England J. Med., 1940, 223, 353).

(b) Pro.—Dealing first with the observations just referred to, I would argue that the mere absence of infection in certain cases or groups does not prove that subjects low in vitamin C do not in fact have a lowered state of resistance to infection. It is not to be supposed that all subjects on diets low in vitamin C are necessarily bound to become infected—it must obviously depend on the nature of the organisms to which they happen to be exposed and on various local conditions. In my own case, when I was restricted to a scurvy-producing diet I did indeed develop an infection (whooping-cough) followed by prolonged infection of the respiratory system which delayed my recovery. My own single positive experience admittedly proves little or no more than one other worker's negative experience—what seems significant however is that the balance of the evidence in recent large-scale investigations, does support the view that the addition of extra vitamin C to war-time diets has increased resistance to infection, has promoted healing of wounds and has improved weight and height gains in children. This new literature is so important that it is worth summarizing it:

Effect of extra vitamin C on resistance to infection, wound healing, and physique.—
(1) In Germany, 1,600,000 children were given 50 mg. of vitamin C daily in addition to the ordinary war-time diet: the children having the extra vitamin C showed improved annual gains in weights and heights and a diminished rate of incidence of infections

(Bull. War Med., 1941, 2, 6; see also Ernährung, 1941, 6, 289).

(2) In Britain, 1,500 adolescent naval trainees took part in a similar experiment. The duration of tonsillitis (although not its incidence) was lowered in those having the extra vitamin C, and complications were lessened. 16 cases of rheumatic fever and 17 of pneumonia occurred in the control group, no single case in the supplemented group

(Glazebrook and Thomson, J. Hyg., 1942, 42, 1).

(3) The later work of Crandon and his associates contradicts an interpretation put by some workers on his earlier study of experimental scurvy. It establishes the importance of adequate intake of vitamin C for the healing of surgical wounds. "A study of preoperative diet and pre-operative plasma vitamin-C levels of patients having operations upon the biliary tract was made. Those with poor intake or low levels or both had a higher percentage of post-operative herniæ than those with better levels" (Lund and Crandon, Ann. Surg., 1941, 114, 776). The investigations of Hunt, the experience of the surgeons at St. Bartholomew's Hospital, and much other evidence all confirm the relation between a sub-optimal intake of vitamin C and the poor healing of wounds.

(4) Similarly, it has been reported that the addition of vitamin C has aided the healing of the alveolus and gingiva after dental operation (Campbell and Cook, Brit. Dent. J., 1942, 72, 6) and has reduced the incidence of some types of gingivitis (Roff and Glazebrook, J. Roy. Nav. M. Serv., 1939, 25, 340; Brit. Dent. J., 1940, 68, 135; Campbell and Cook,

Brit. M. J., 1941 (i), 360).

(5) Indirectly, the increased incidence of infantile scurvy (e.g. Paterson and Daynes, Brit. M. J., 1941 (ii), 787) and of scorbutic gingivitis (reported by several observers) supports our contention: because, for every such case of developed deficiency disease,

there must be others of less advanced, or sub-clinical deficiency.

Need for tests to measure levels of nutrition.—If we are satisfied, then, that there is such a thing as a partial deficiency—and facts similar to those just summarized could be cited for the other vitamins—we may next consider how it is to be detected. Two facts emphasize the urgent need for such tests. First, the onset of advanced deficiency may be disconcertingly abrupt: for example a subject with a low prothrombin figure due to hypovitaminosis-K may be free from hæmorrhage, but the moment this value falls below a certain critical threshold hæmorrhages will suddenly supervene. It is of supreme value therefore to be forewarned. Similarly, the transition from a state of sub-clinical deficiency of vitamin C to actual scurvy may be precipitous. Secondly, it is important to be able to follow the effects of restrictions in the national diet and keep a watchful eye on any

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tokens of falling levels—this can be done by examination of representative groups of the population.

Saturation tests for vitamin C.—The principle of the "urinary saturation" method for vitamin C, to which I alluded at the outset, is as follows: Standardized test doses of vitamin C are given daily under controlled conditions, and the number of days is counted until the subject is approaching his plateau of excretion. With children who have been receiving the reputed requirement of vitamin C (30-50 mg. per day!), saturation, so defined, is attained on the first or second day. With developed scurvy seven to ten days of such dosing are needed (this being a measure of the extent of unsaturation of the tissues). An intermediate number of days needed to saturate denotes an intermediate level of nutrition, in proportion—as has been proved by control tests on groups of subjects receiving various graded intakes. Thus we have satisfactory standards of reference. Fortunately, the amount of "scatter" in the responses of different subjects receiving the same known intake is relatively small, and less than might perhaps have been expected. To remove a misapprehension which still seems to persist, it is necessary to emphasize that we are not concerned with "saturation" or "unsaturation" as such—e.g. whether saturation is desirable or otherwise—but with a quantitative measurement of the degree of saturation, merely as an indication of the level of the past intake.

Results with vitamin C.—Our tests during the war (Lancet, 1942 (i), 642) have shown one thing in common with those before the war. Children at a well-conducted residential institution were consistently at higher levels of vitamin C than those from poor workingclass homes. However as a result of the war both groups had sunk to considerably lower levels than the corresponding groups examined at the same season before the war. conclusion applies to the results after the winter, and it can undoubtedly be attributed to the relative shortage of fresh fruits and other carriers of vitamin C during the winter in war time. (It may be noted that potatoes are the principal source of vitamin C in winter, and about 11 oz. of them daily are needed to provide only one-half, 15 mg., of the League of Nations requirement of the vitamin, 30 mg.) Perhaps the most striking result was this seasonal variation. After the summer all groups of children examined were at a reasonably high level. After the winter, however, most of the poor working-class children examined during the war needed four days and upward to saturate, whereas before the war the great majority of such children have been saturated within two to three days. Such results emphasize the need for care in providing vitamin C during the winter months. They amply justify the decision of the Government to set aside supplies of vitamin C for young children many of whom, as we have demonstrated, may be severely below standard in the absence of such precautions.

Vitamin A.—My colleagues and I have been specially interested in the dark-adaptation test for detecting sub-clinical deficiency of vitamin A. The method can be made sufficiently specific for vitamin A by the simple expedient of ascertaining whether each subject fails to improve in absence of vitamin A but responds after it has been administered in large quantities. Experimentally it has been repeatedly proved that individuals deprived of vitamin A show a progressive fall in their dark adaptation curves and improve when vitamin A is restored to their diet: we therefore have here an excellent example of a sub-clinical deficiency—the individual is free from clinical signs and symptoms and the presence of an undoubted defect is only discovered on laboratory examination.

Some years before the war my collaborators and I found a fairly high incidence of dysadaptation due specifically to low intake of vitamin A in certain poor districts in London and Cambridge, and this was correlated with a low consumption of milk among the children found to be deficient. The position is undoubtedly better now, notwith-standing the war, for very much more milk is drunk in schools than was then, margarine is fortified with vitamin A, and—a surprising enough observation—raw carrots in cellophane wrappings are supplied by tuck shops and relished by the children in the absence of the wonted sweets and chocolates. My colleague Dr. John Yudkin who has been carrying out nutritional surveys on factory workers and school children during the war has found low adaptation in 9% of children at an urban institution, 15% among urban children from poor homes and 18% among some village children. He has confirmed that the majority of such subnormal children responded after vitamin A. Among medical students and nurses 6% were low in adaptation, judged by arbitrary standards and a higher proportion among factory workers.

An alternative method of detecting deficiency of vitamin A, suggested by Kruse, is to examine for ocular changes (in the conjunctivæ) by means of a slit-lamp; as Kruse admits, however, these ocular lesions are not the sole, first or most important abnormality. Moreover the impression of my colleagues is that the changes detected by slit-lamp seem also less frequent and less severe in children than in adults.

Partial deficiency of riboflavin.—About 4% of the school children so far examined at Cambridge were found on examination of the cornea by slip-lamp to have pathological vascularization at the limbus—the sign used by Sydenstricker and others to indicate preclinical deficiency of riboflavin.

Hæmoglobin.—In the experience of my colleagues, anæmia (hæmoglobin value of under 80%) was found among factory workers (Birmingham district) in 20% of the women and

5% of the men.

B vitamins.—A saturation test, somewhat similar in principle to that used for vitamin C, is available for vitamin B<sub>1</sub> (Wang and Harris, Biochem. J., 1939, 33, 1356; Wang and Yudkin, ibid., 1940, 34, 343) and also for nicotinamide (Harris and Raymond, Biochem. J., 1939, 33, 2037; Kodicek and Wang, Nature, London, 1941, 148, 23). For vitamin B<sub>1</sub> a special carbohydrate-tolerance test is also a possibility. The substitution of flour of 85% extraction for white flour has, however, largely removed the likelihood of serious deficiency of both these factors. As Kodicek (Lancet, 1942 (i), 380) pointed out the previous war diet with white bread was dangerously near the margin of adequacy for nicotinic acid, and it may be remarked in this connexion that there was the suggestion of an increased incidence of pellagra in N. Ireland (Deeny, Brit. M. J., 1942 (i), 147).

Conclusion.—Recent work has made it abundantly plain that ill-effects result from partial deficiencies even when signs and symptoms of frank deficiency disease are absent. Methods are now available for assessing the levels of nutrition in specific dietary essentials. Results obtained in surveys, using certain of these methods, are described in this contribution. The need for such surveys is particularly apparent with the restrictions in

diet imposed by the war.

Dr. H. M. Sinclair reminded the meeting that the discussion was on "Mineral and Vitamin Requirements" and not on the incidence of malnutrition in the population

or the reality of partial deficiencies.

Dr. Harris had quoted the excellent work of Fox which, however, was not wholly negative. Fox had 950 natives in each group, one group getting 12-25 mg. vitamin C per diem and the other an additional daily 40 mg. Apart from the incidence of scurvy, there was no significant difference between the two groups: weight, general health, physical efficiency, resistance to infection, healing of wounds and fractures were all studied,

and the additional vitamin C failed to have any effect upon them.

Iron deficiency was one of the most prevalent deficiencies in the present diet and the Blood Transfusion Service enhanced it: we took blood, kept the plasma and threw away the cells (or, when we were more sensible, we used them for garden manure). Viewed academically, the cells, supplemented perhaps with dried blood from slaughter-houses and a few iron railings, might be added to the nation's bread, but some would regard that as cannibalism. From the practical point of view there was an overwhelming case for adding to bread traces of iron salts that were available to the body.

Dr. A. P. Meiklejohn: It would be interesting to hear Dr. McCance's opinion on the

advisability of adding traces of iron salts to the bread.

Would Dr. Harris be prepared to give a more exact definition of "subclinical" deficiency? An individual who excretes only a small amount of a given vitamin, but subsequently, after receiving large doses of the vitamin, has a greater excretion, was not necessarily suffering previously from an impairment of health through lack of this vitamin. Even if he says that he feels better after receiving the vitamin, the possibility of improvement through suggestion must be kept in mind. The results of the "test-dose" method of assessing subclinical deficiency need to be correlated with the actual state of health as assessed by clinical methods.

Dr. R. A. Murray Scott: From the clinical point of view anæmia is the only mineral deficiency likely to be evident. Unfortunately we find no large-scale statistics to show whether anæmia is more prevalent to-day than pre-war, yet what reports are available

show a present-day tendency to increase in anæmia.

There are descriptions in the literature of increased anamia among small groups of pregnant women and nurses. Medical and obstetrical opinion in my part of the country (and in some other parts) quite definitely assert increasing anamia and more Fe used by doctors and chemists; a survey of miners being conducted in Yorkshire at the present time shows no gross anamia, but examination of their wives brings to light a considerable reduction of N. Hb. among the latter, the reason being their menstrual loss, and the fact that the miner frequently eats the whole of the animal protein food in the ration of the family.

Leeds second year medical students have for several years estimated their own Hb. When the results are divided into groups covering 5% divisions, the numerically largest group has been in the 100-105% Hb. division, for the six years prior to this war. Last

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year, the largest group was the 90-95% division. I have no reports of an increase in the Hb. compared with pre-war in any section of the community.

Sir John Boyd Orr's survey of 1935-6 showed that the poorest 10% of the community averaged 8 mg. of Fe as the daily intake, and that 50% of the community had an intake of less than the 11.5 mg., a figure taken as the requisite minimum. Since then, rationing and restrictions have made alterations in the nation's diet. The poorest to-day can scarcely afford to buy their share of the rationed animal protein food. It is possible that the limitation of sugar increases their consumption of flour and potatoes, which helps to increase The richest section is restricted in variety, but can still find their mineral intake. sufficient unrationed foods to maintain a diet of high mineral content.

In August 1941 I made a careful survey of prices, which I sent to the Ministry of Food, showing that for an active man a complete optimum diet with reasonable variety could not be purchased for less than 14s. a week, and this amount was spent only by Boyd Orr's most wealthy 10%.

A similar diet for a sedentary worker costs 11s. a week, an amount spent by one-third of the community in 1935-6. Wages, and the prices of foods have risen since then.

Now the rationed foods-meat, bacon, eggs, cheese-contain about 25.6 mg. Fe in the week's ration, of which only part is available. Authorities vary on this question—the available Fe being given as from 7 to 14 mg., i.e. 1 to 2 mg. per day. In 1935-6 the poorer half of the community obtained half of their 10 mg. Fe per day from bread and flour, potatoes, and legumes. Apart from the poorest 10% it is unlikely that these people will eat much greater bulk of these foods, unless they are doing harder work.

The rationing of meat, bacon, eggs and cheese reduces their intake of Fe from 3 mg, to 1 (or from 6 mg, to 2 if one takes the higher values quoted above), so that there is a theoretical expectation of an increasing anamia among the poorer half of the nation.

The problem arises as to how to increase the Fe of their diets.

If the Fe of the whole wheat berry is available for absorption, the increase due to the substitution of 85% extn. meal for 75% (i.e. white flour) would increase the Fe of the diets of the great majority by 2.5 a day. (I take the figure of 8 mg. Fe per lb. of 85% extn. bread, as given me by Professor Drummond.) This would bring the total Fe to over 10 mg. a day.

From	rationed foods						1.0	mg.	
	bread and flour						5.5	mg.	
	potatoes and legi	imes (	Boyd	Orr)			2.0	mg.	
	points rations, un	ration	ed me	ats, fish	, &c.	* * *	2.0	mg.	
Substi	ituting white brea	d for	85%	•••	• • •		10.5	mg. per	day

Before I consider the availability of the Fe of bread, I should like to clear the air with regard to the "man v. cow" problem, in the light of what I have learned from agricultural and milling experts,

From the point of animal feeding stuffs, it is necessary to estimate the effect of raising

the extraction of wheatmeal to 85%.

As we all know the wheat berry consists of a central endosperm (or white flour), occupying 75% of the whole berry, and containing a small amount of Fe. Outside this is the germ layer-2% of the berry. This in turn is surrounded by fine bran, called weatings, and outside all is the coarse bran. Germ, weatings and bran are all rich in iron.

Coarse bran is a complete, balanced food for the milch cow. The weatings, however, are not, and are fed to pigs and poultry, which have not the necessary apparatus to make use of bran, on account of its roughage.

As the coarse bran of cattle feed is not used for the manufacture of 85% meal, the substitution of the latter for white flour will not affect our milk supply. But the use of some of the weatings in the new flour will deprive pigs and poultry of a part of their present food supply. Even the entire removal of bacon and eggs from the nation's rations (and this, of course, is far from the case) would cause a loss of Fe of less than

Looked at from the point of view of mineral constituents, the innovation of 85% extraction bread increases the Fe of the average diet by about 2.5 mg. per day, without disturbing the supply of Ca or P which comes from milk. Superficially then, from this

standpoint, the change in bread is all gain. It is now essential to consider fully the rather startling report of Widdowson and McCance (Lancet, 1942 (i), 588), suggesting that the higher extraction meals are a poorer source of available Fe than is white flour. From the data obtained from their experiments their conclusions appear just, but they cut so firmly across one's general ideas that one scrutinizes them with a mind even more critical than usual.

One could have wished for more clinical data—evidence of lack of energy or fall in Hb, when the subjects were on the brown bread diet, evidence as to whether they showed a tendency to an increase or decrease in the absorption of Fe on the third week of brown bread diet compared with the first week; i.e. evidence of the possible acclimatization to brown bread; evidence as to whether any of them was an habitual eater of brown bread prior to the experiment, how many of the subjects had loose stools on brown bread, how much Ca their diets contained and whether there was enough to supply their needs of this metal and in addition precipitate any phytic acid in the brown bread (for we cannot allow Mellanby's dogs to get rickets and Widdowson and McCance's subjects to become anæmic at the expense of the same phytic acid); evidence as to the age and state of physical health of the 8 subjects of experiment.

This problem of availability of mineral constituents of higher extraction meals is of particular importance in view of recent work on the value of the components of the vitamin B complex, which must be kept firmly in mind. (Meiklejohn, New England J. Med., 1940, 223, 265, 224, 420; Williams, Mason, Wilder and Smith (Mayo), Arch. Int. Med., 1940, 66, 785; &c.)

One must not forget the other side of the picture (here I confess I am being quite non-scientific)—those country folk the world over who eat wholemeals of one sort or another, the schools which supply only whole wheatmeal, and those who from preference or persuasion eat little other cereals, and are usually very healthy, vigorous, non-anaemic persons.

Let me give an illustration from my own household. Two adults—one of each sex, both aged 41 years—both from preference eat wholemeal almost entirely. They occasionally eat a little national bread. Both eat porridge regularly—another source of phytic acid. Subject A eats all vegetables in fair quantity, thus finding a source of additional Fe and Ca. Subject B has average menstruation, eats little potato and less green and root vegetables. Of other foods both are small eaters, the rationing of meat scarcely alters their diets. I find in their diets no other source of Ca or other mineral to precipitate phytic acid except those provided by an average war-time diet. Both subjects are extremely active persons. Yet on May 23, 1942, Subject A had an Hb. of 100%, Subject B 102%. How does their Fe escape the clutches of the phytic acid?

This is a matter not only for speculation, but for examination. Our ancestors thrived on wholemeal, and some of us obviously can thrive on wholemeal. When given a diet of white flour for some years, does our metabolism lose its ability to deal with phytic acid? On presenting it once again with wholemeal does it in time resume a lost function? In other words, does phytic acid always steal minerals from the diet, or are there other circumstances under which the P of phytic acid becomes precipitated? To conclude:

(1) There is evidence of anæmia in this country—probably greater than pre-war.

(2) Most diets contain less total Fe than pre-war.

(3) It is important to solve the question of how to increase the available Fe in the nation's diet, preferably through the medium of bread as the staple food of most diets. I suggest:

(1) If the medical profession and scientists are in future to advise on (and I hope direct) the health of the nation, an *Annual* survey of Food, Health and Income is imperative.

(2) Experiments should be done to find what salt of Fe can be added to bread to increase the available Fe without interfering with other qualities. I have not succeeded in finding a description of such work in connexion with the enriched flour used in U.S.A.

(3) The very interesting experiment of Widdowson and McCance should be repeated on a larger number of persons with full clinical control.

Dr. Geoffrey Evans reported his experience of a variety of deficiency states, and spoke of glossitis in which some cases were relieved by nicotinic acid: of cheilosis and several cases of acne rosacea much improved, and indeed on occasion apparently cured, by the administration of riboflavin: of vitamin B<sub>1</sub> deficiency shown in loss of appetite and gastrointestinal disturbance: of intellectual lethargy shown in mental fatigue and lack of power of concentration, as well as cases of neuritis, in which last also it seemed that vitamin B<sub>1</sub> given in larger doses had contributed to recovery. Dr. Evans also spoke of the relation of vitamin C deficiency to gingivitis. He expressed the opinion that vitamin D deficiency was on occasion responsible for muscular hypotonia, in terms of which he explained certain cases of so-called rheumatism in the back. In relation to vitamin D deficiency he mentioned a family in which there seemed to be evidence of failure of vitamin D assimilation or utilization in spite of adequate supply, in which family there was evidence of this deficiency in two generations. He particularly emphasized the frequency with which in his practice he found a subnormal hæmoglobin content of the blood. Dr. Evans concluded that in his experience minor deficiency disease is of quite frequent occurrence,

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and that so far as vitamin supply is concerned, because of the variety of deficiency, for the improvement of their health the population should be made food conscious rather than vitamin conscious.

Professor J. R. Marrack said that in March and April he had estimated the ascorbic acid in a number of meals, as served, both in school canteens and in British restaurants in Hertfordshire and in Bermondsey, Islington and Leytonstone. He had found no evidence of excessive destruction of ascorbic acid in the preparation and cooking of the vegetables. Taking average helpings, the total ascorbic acid supplied by one-third of the meals was under 10 mg.; one-third supplied over 20 mg.

He had made saturation tests on boys at three schools. At School A the average amount of ascorbic acid in a dinner was 8 mg.; one-third of the boys were saturated of the third day of the test. At School B, average ascorbic acid 16 mg.; two boys out of three saturated on the third day of the test. At School C, average ascorbic acid 24 mg.; one-third of boys saturated on first day, two-thirds on the third day. Except for one boy at School C (saturated on first day) who ate raw vegetables at home, the boys depended almost wholly on their dinner for their supply of ascorbic acid. All three schools had garden plots, School A grew a large amount of potatoes, which were plentiful and cheap, and did not produce enough green vegetables which were scarce and dear. School B grew a better choice of vegetables and supplied a raw vegetable meal (ascorbic acid content 21 mg.) once a week. School C grew abundant early green vegetables. The choice of vegetables grown in the garden plot determined the amount of ascorbic acid in the school dinners and the state of nutrition of the pupils in respect to vitamin C.

Too much faith should not be placed in the use of raw vegetables. The weight of vegetable, that would be regarded as an ordinary helping when cooked, looks an enormous amount when raw. In the first week of April he had estimated the amount of ascorbic acid in the plasma of girls at an Institution in which raw vegetables were served. In all the concentration was under 0.3 mg. per 100 ml.

Lieut. W. R. G. Atkins, F.R.S., asked Dr. Leslie Harris for what period it was possible to detect previous saturation with vitamin C and stated that forty men who had had large doses of the vitamin in January, up to saturation in the majority, had been examined again four months later. Many were then indistinguishable from their fellows who had never been dosed. The men of the group as a whole were only slightly higher in vitamin C than those who had received no added vitamin. Thus the administration of extra vitamin appeared to result in an increased utilization or excretion, or in both.

In the discussion on mineral requirements Lieut, W. R. G. Atkins drew attention to the importance of foods derived from the sea, since the latter was a reservoir for many or all the trace elements. Some, however, such as iron, were precipitated, so that sea water was richer in copper than in iron. Copper indeed was a constitutent of the respiratory pigment of the crustacea, as was vanadium in the holothurians.

Mr. A. L. Bacharach thought the only possible explanation of Fox's results was that both groups of natives were suffering from multiple deficiencies; in that event, it was quite likely that the only demonstrable effect of ascorbic acid would be to prevent frank scurvy, which it seemed to have done in a significant number of treated cases. The effect of multiple deficiencies in preventing an individual vitamin from exhibiting its normal function was nothing new, as, for example, had been shown in the well-known Peterhead investigation. Unsaturation with vitamin C was, as Dr. Harris had pointed out, an indication of the state of nutrition of groups, and not of any individual, at a given time. It could, however, be an indication of the level of nutrition of an individual if, as a result of repeated observations, it were found to be chronic. It seemed impossible to avoid the implication that the permanently unsaturated individual must be nearer the scorbutic border-line than the permanently saturated one, even though the latter were actually receiving more than was necessary for the prevention of any specific sub-scorbutic manifestation.

Dr. McCance (in reply) stated that there was some evidence that hæmoglobin levels were lower now than in 1938, but that he felt more careful investigations should be made before any dogmatic statements were made. He thought that very small amounts of iron could be added to bread quite satisfactorily, unless the addition catalysed the destruction of any of the vitamins. Iron could also be added to table and cooking salt, and this might be a more practical way of increasing the nation's iron intake. Apropos of his experiments with Dr. Widdowson which had been discussed by Dr. Murray Scott, Dr. McCance pointed out that although there had been the fullest possible clinical control, there were no clinical data to give. He himself and his subjects had been very well all through the nine months of experimentation. There was no evidence of "acclimatization" to brown bread, nor would he expect to find any. Dr. Scott would find answers to his other queries in J. Physiol., 1942, 101, 44.

Dr. Harris (in reply) said that Dr. Sinclair had questioned whether in this discussion, dealing with "Mineral and Vitamin Requirement in Relation to War-Time Dietary", a contribution on partial deficiencies and their incidence was in place. He maintained—in agreement with the Committee, who had invited him to speak on that particular topic—that it certainly was. The evidence which he had tried to present proved that various groups of apparently normal subjects when given, for example, extra vitamin C in addition to their war-time diet benefited, on balance, in such ways as improved physique, diminished incidence of infection and better healing of wounds. How, then, could one pretend adequately to discuss vitamin requirements in relation to war-time dietary without a consideration of the fact that an intake which was sufficient to prevent deficiency disease was not always sufficient to prevent these sub-clinical defects, or without noting that the minimal requirement was therefore very different from the optimal requirement, and hence without some attempt to estimate whether war-time dietaries did or not meet the reputed requirements for optimal nutrition (i.e. by measurement of incidence of undernutrition).

Dealing with resistance to infection, Dr. Harris said that the balance of evidence indicated that it was liable to diminish when the intake of vitamin C was low. This of course did not mean that every such person, or every such group would always become infected—it would depend on the extent to which they were exposed to infection and other limiting factors. Hence the negative experience in Fox's test, to which Dr. Sinclair had once again alluded, was not conclusive. A negative result in a trial of this kind might mean very little, whereas a positive result was of more significance. Similarly for healing of wounds and the other effects mentioned—taking into account all the published data, the

balance of evidence was for a positive effect.

In reply to Dr. Meiklejohn's request for a definition, Dr. Harris said that a group of children had sub-clinical deficiency if, although apparently normal at inspection, it could be shown statistically that after a period on an increased vitamin intake they improved as a group (e.g. in yearly gains in weight and height, morbidity rate, and in the other effects mentioned) as compared with controls kept on the unsupplemented diet. There would not necessarily be a detectable improvement in each individual. Numerous trials

had now proved that such sub-clinical deficiencies did in fact exist.

Dr. Meiklejohn had missed the point in asking whether there was really any need for saturation. Dr. Harris had never claimed that there was. As he had been at pains to emphasize in his paper, the object of the saturation test was to determine quantitatively the relative position of the subject or group in relation to any accepted standard of intake. Control tests had shown that with various graded levels of intake of the vitamin there resulted corresponding graded levels in the degree of saturation, as measured by the number of days needed to saturate. Hence from the result of the saturation test one could say whether a given subject had a level above or below that corresponding, for example, with the L.o.N. standard (30 mg.). If some alternative standard of intake were preferred, the results of the saturation test were still applicable, just as a series of hæmoglobin estimations did not lose their significance whether one preferred to refer them to a standard of 100% or of 95%. The chain of arguments connecting saturation tests with clinical findings was as follows: It was known that a dose of about 15 mg. of ascorbic acid was just sufficient to prevent actual symptoms of scurvy in most people; allowing a small margin, the L.o.N. had fixed the daily requirement as 30 mg.; according to some U.S.A. authorities the true optimum was probably 50-75 mg.; health had improved in trials in which ordinary, marginal intakes of vitamin C as consumed in the war-time diets had been supplemented with additional vitamin; and, finally, the purpose of saturation tests was to enable the observer to determine the relative position of the subject or group within such scales of intake. The question of whether or not a person felt better after a test dose did not of course arise, and the supposed analogy with the excretion of a drug like bromide after medication was entirely false,

In reply to Dr. Atkins, Dr. Harris said that vitamin C was not stored in the body to furnish a reserve to any considerable extent. In this respect vitamin C (and the other water-soluble vitamins) stood in contrast with the fat-soluble vitamins. The length of time taken for scurvy to develop in guinea-pigs, and apparently also in man, was not considerably increased even if the subject was given a great surplus of the vitamin, instead of his normal allowance of it, for a time before going on the deficient diet. Any surplus thus given was mostly excreted. Thus in the saturation test one was not concerned with the body's "reserves" so much as with the "degree of saturation" of the tissues. In other words the effect of a massive over-dosing was not lasting, and the result of the saturation-test indicated the average level of intake during the few months prior to the test.

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## Section of Comparative Medicine

President-G. DUNLOP-MARTIN, M.R.C.V.S.

[February 18, 1942]

## DISCUSSION ON THE CONTROL OF THE DISEASES OF CATTLE INIMICAL TO MAN

## Mastitis and Streptococcal Infections

[For previous Discussions see Proceedings, 35, 115, 469, 478]

Dr. A. W. Stableforth discussed mastitis with reference to a series of tables under the following headings: the various kinds of mastitis, the importance of mastitis from a national viewpoint, the financial loss, the methods of diagnosis, sites in which Str. agalactiæ is found and methods of infection and the various methods of prevention, control and treatment. The three more important tables are reproduced.

			TABLE I	
	The kinds of ma	stitis	The bacteria concerned	The outstanding features
(1)	Common chronic stre	p. mastitis	Str. agalactiæ (Str. mastiditis cont. Group B (Lancefield) Mastitis Group I)	Widespread, incidence 35% of milking cows; many carriers or mild cases, but causes more clinical mastitis and loss of milk than any other
(2)	More acute strep. ma	stitis	Str. dysgalactiae (Mastitis Group II)	Sporadic, acute or subacute, few carriers, serious in some herds
	13 22		Ser. uberis (Mastitis Group III)	Sporadic, usually subacute, some carriers
	37		Str. pyogenes equi ("Animal pyogenes" Group C (Lancefield))	Uncommon, acute, carriers rare
	33 31		Str. pyogenes (Group A (Lancefield))	Rare, acute, carriers rare
(3)	" Summer mastitis "		C. pyogenes	Heifers and dry cows, acute, purulent toxic, very serious in some herds and years
(4)	Staphylococcus mastil	tis	Staph. aureus	Usually mild, chronic, fairly widespread; but may be acute, toxic and gangrenous
(5) (6) (7)	Coliform mastitis Tuberculous mastitis Other forms		Various coliforms M. suberculosis F. necrophorus, pasteurella, &c.	Rare, acute, toxic Nearly always " cold," chronic and focal Rare

#### TABLE II.-WHY MASTITIS IS IMPORTANT FROM A NATIONAL VIEWPOINT

- Occasional loss of the cow or more frequently loss of one or more quarters or the production of unsaleable milk.
   Increased herd wastage.
   Lowered milk yield even in non-clinical cases.
   Changes in milk quality: decreased fat, casein and sugar, increased alkalinity and salt content which may interfere with cheese-making.
- (5) Mastitis may be caused by human streptococci and the milk be dangerous to human beings drinking it.

### TABLE III.—THE LOSS FROM MASTITIS.

- (1) Comparison of 86 opposite infected and non-infected quarters (Str. agalactiæ).

  Milk yield of infected, 21% lower
  Butter fat of infected, 25% lower
  (2) Comparison of yield of approximately equal numbers of affected and non-affected over 373 lactations in 3 herds.

  Corrected for calvings, dry period, month of calving, &c.

  Take loss at 12% and incidence of mastitis infection at only 25%.

  Cows in England and Wales = 3,200,000 Average yield = 450 galls.

  25% affected = 800,000 12% loss = 54 galls.

  Total loss = 43,200,000 galls, at 1/6 gall. = 43,240,000 (N.B.—In these herds nearly all mastitis was of the common chronic type met with in most herds and there was no outbreak.) outbreak.)

## The Control of Str. agalactiæ Mastitis

Str. agalactiæ mastitis is a chronic disease in which a large proportion of infections remain latent and despite the low morbidity rate, it is responsible for more clinical cases than any other and for a loss of milk greater than all other forms of mastitis.

As far back as 1887 the organism now generally known as Str. agalactiæ was labelled Str. mastiditis contagiosæ and it is to be presumed therefore that it was regarded as contagious and infected cows isolated. Later, when it was recognized that many cows showed slight changes in the milk at an early stage, various indirect tests were made use of to detect carriers: from 1906 onwards the sediment test, from about 1919 the reaction test and cell count and, a little later, the chloride test, catalase test and certain others. In 1933 evidence was brought forward in this country which appeared to show that the disease could be eradicated within a reasonable time by three-monthly cultural milk tests and segregation or sale of the infected animals. In one herd no Str. agalactiæ had then been found for three and a half years and none were in fact found during the succeeding six years whilst promising results were being obtained in other herds. Reports suggesting that the disease might be controlled by similar methods but with the aid of chemotherapy appeared from abroad at about the same time and others affirming eradication have since appeared. Meanwhile we had continued our attempts to eradicate the disease in other herds and, finding that new infections continued to appear, introduced a liquid enrichment medium. In this way a certain number of additional infected cows were found. It was also found, however, that these additional new infections, undetected by the plate method, continued to be found by the enrichment method and, secondly, that many of the new infections so found were never detected again or only infrequently and, moreover, were seldom followed by clinical symptoms or more marked infection. In 1935, therefore, we reverted to the plate method alone. This method though scientifically unsatisfying in view of the findings already mentioned seems of value because its use has resulted in the reduction of clinical Str. agalactive mastitis to negligible amounts, i.e. it appears to have a real practical value. Since 1935, many other reports have appeared showing that the more searching the methods and the more frequently they are used, the greater the number of infections detected. It has also been shown that Str. agalactiæ can be resident on the skin of the udder and milker's hands. Further that an infection can be detected in a higher percentage of freshly calved heifers than was at first believed (percentage is probably about 10). All of this raises seriously the question whether regular cultural examinations are worth while. When eradication within a reasonable time could be held out as a probable result the cost of regular cultural examinations was clearly justified. With the knowledge now before us, however, the question is more debatable and in present circumstances we have to realize that as part of a national scheme regular cultural examination is quite impracticable.

### The Parasitic Standing of Str. agalactize

The position as already referred to also raises another question of some importance, viz., the parasitic standing of *Str. agalactiæ* and, associated with this, the host-parasite relationship in *Str. agalactiæ* infections and the importance of those factors previously generally regarded as predisposing or secondary factors. There are available, certain facts bearing on this question.

In a large proportion of clinical cases of mastitis Str. agalactiæ is the only organism to be found and it is present in large numbers. It is known to ferment lactose and clot milk and mastitis secretions are often acid though secretions less altered are relatively alkaline; the alkalinity may be, however, the result of a compensatory mechanism for the injection of acid solutions into the udder is quickly followed by an alkaline reaction. Str. agalactiæ has not been found in the bovine except in the udder or places closely associated with it, e.g. the skin of the udder, milkers' hands, bedding; and, in one laboratory, in a small percentage of fæces. Attempts to set up infection experimentally (in adults) have, with one exception, only been successful when the route was the teat or teat canal. On the other hand heifers may be found to be infected at the beginning of their first lactation; the exact route of infection is not known but infection probably occurs in calfbood. In self-contained infected herds all or nearly all of the infecting strains usually belong to the same serological type and subtype and even show the same minor cross reactions, and this serological herd similarity has also been established in certain outbreaks amongst heifers, or cows which were previously negative, i.e. there is evidence that a given type spreads in the herd. The incidence of both Str. agalactiæ infections and clinical symptoms increases with age. On the other hand, it is well known that of two herds with an equally high incidence of the same type of Str. agalactiæ, one

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may have practically no clinical mastitis, whilst the other has a great deal, and in two herds which are similar as regards incidence one may suddenly show an outbreak of clinical symptoms. Sometimes this is referable to some outside factor such as the introduction of a milking machine. Sometimes nothing can be found to account for it. Again, although on the whole, clinical symptoms of a minor or major nature increase with the age of the infection, many cows can carry a heavy infection for years without showing symptoms of a marked nature and indeed often without showing any symptoms at all, whilst other animals in the same herd and carrying the same numbers and type of streptococci show marked symptoms.

What are the reasons for these paradoxes? Are they really dependent on the factors already well recognized, such as inefficient milking and management in its broadest sense and on injury, or is there some other factor, virus, physiological or hormonal which decides whether the streptococci shall exert their potential pathogenic effects?

There is much to be learnt about Str. agalactiæ mastitis and indeed mastitis in general and certain aspects stand out for early study.

More figures are required for the incidence of the various kinds of *clinical* mastitis.

The study of the treatment of mastitis should include mastitis other than Str. agalactiæ mastitis.

A careful comparison might usefully be made of the value of control by (a) hygienic measures alone, (b) hygienic measures plus simple indirect tests and (c) hygienic measures plus regular cultural examinations.

Finally, an intensive study of the unknown factors in the pathogenesis of the disease

is urgently needed.¹

Dr. V. D. Allison: Bovine mastitis is predominantly an infection due to streptococci, with staphylococci next in order of importance, and infections caused by streptococci and staphylococci are problems in both human and veterinary medicine. Milk-borne streptococcal outbreaks in human beings are caused by strains of streptococci belonging to Lancefield's group A. Str. pyogenes, while streptococcal mastitis in cows is pre-eminently the result of infection with streptococci belonging to Lancefield's group B. Streptococcal mastitis does not bear the same importance in relation to public health and the practice of preventive medicine as that shown by infections such as tuberculosis and brucellosis.

The distribution of groups of hamolytic streptococci from various sources in human beings in the absence of disease is shown in Table I, and shows that group B streptococci are infrequently found in human beings. Table II, reproduced from a paper by Hare

TABLE I.—GROUP DISTRIBUTION OF HÆMOLYTIC STREPTOCOCCI ISOLATED FROM HUMAN BEINGS IN THE ABSENCE OF DISEASE

	No. of	Group distribution per cent.										
Source	strains	A	В	С	D	E	F	G	Н	K	3	Authors
Nose and Throat	100* 50† 45	63	5	15 20‡	Ξ	=	24 42·2	13	50 26	7 16	10	Hare (1935) Coffey (1937-8)
Fæces	109	-	5.5	0·9 9·1	84-4	0.9	-	8.3	_	_	-	Smith and Sherman (1938)
Vagina ante-partum	ante-partum 11		— 45·5		_	-	-	45-5	45.5	-	- 1	Lancefield and
Vagina post-partum	66	1.5	39-4	7.5	39.4	-	3.0	4.5	_			Hare (1935)

TABLE II.—GROUPS TO WHICH STRAINS OF HEMOLYTIC STREPTOCOCCI FROM INFECTIONS

\* Producing soluble hæmolysin. † Not producing soluble hæmolysin. ‡ Includes group G strains.

		No. of				Strep	tococci	l group				
Source	Disease	strains examined	A	В	C	D	E	F	G	Н	к = - - -	7
Throat	Scarlet fever Tonsillitis Ac. rheumatism	117 77 9	115 73 9	Ξ	3	-	=	_	1	=	=	2
Skin	Erysipelas	28	23	_	5	_	_	_	_	_	-	
Uterus	Puerperal fever Abortion	194 12	189	1 9	2	1	_	_	1	=	=	1
Tissues	Lymphangitis	15	14	_	-	-	-	-	1	_	-	
	To	tals 452	431	3	11	1	0	0	3	0	0	3

\* Reproduced from HARE, R. (1937), Canad. Pub. Health J., 28, 554, 596.

1 Whilst detailed reference to the literature on mastitis cannot be made, the writer would express his indebtedness to his one-time collaborators, and in particular, Dr. F. C. Minett, his former chief.

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(1937), similarly shows the distribution of groups of hæmolytic streptococci found as the cause of disease in man and again it is seen that Group B streptococcal infections play a very minor role.

Table III summarizes the human group B infections which I have been able to cull from the literature of the last five years. It is interesting to note that all the cases

TABLE III.—HUMAN INFECTIONS WITH HÆMOLYTIC STREPTOCOCCI
BELONGING TO GROUP B.

Authors N	lo. of cases	No. fatal	No. with endocarditis	No. associated with pregnancy
Congdon (1935)	1	1	7.6	1
Lancefield and Hare (1935)	7 ±	0	0	7
Colebrook and Purdie (1937)	1	1	1	1
Coffey (1937-8)	3	2	7.6	2
Fry (1938)	3	3	2	3
Hill and Butler (1940)	12*	4	2	12
Pomalés-Lebrón (1940)	1	1	2.6	1
Rosenthal and Stone (1940)	1	ĩ	1	1
Ramsay and Gillespie (1941)	16†	2	2	16
Fry (unpublished)	4	2	1	3
	_		_	_
To	otal 49	17	9	47
* Including some minor int	fections.		± All :	minor infections.

\* Including some minor infections.
† Genital tract sepsis in 13 cases, none severe.

‡ All minor infection § No data available.

(except one reported by Coffey (1937-8) in which the sex is not mentioned) occurred in women and that 47 out of a total of 49 were associated with pregnancy. Seventeen of the cases proved fatal and at least nine of these had endocarditis. It would be interesting to speculate on the source of these group B infections in women. Taking into consideration the somewhat high incidence of group B streptococci found by Lancefield and Hare (1935) in the vagina of women both ante-partum and post-partum, and the finding of group B streptococci in normal fæces by Smith and Sherman (1938), I suggest that the gut is probably the main source of infection. Lancefield's (1940-41) findings indicate that the same specific types of group B streptococci may be found from both human and bovine sources, although Simmons and Keogh (1940) had concluded that types of group B streptococci indigenous to man and cattle are quite distinct and that human carriers are not, therefore, the source of infection in cattle. Further investigation of this question In addition to the infections in Table III, Brown (1939) and Rantz and Keefer (1941) have reported a number of cases of human infections with group B streptococci; these do not lend themselves to inclusion in the table, but the strains were isolated from the blood during life and post mortem, from pelvic abscesses, arthritis, gangrene, sinusitis, &c. More than half the cases in which the group B strains were considered to be of ætiological significance proved fatal. The sex of the cases was not given but probably a few were males; in view of the now almost routine procedure of grouping hæmolytic streptococci from human infections by the Lancefield test or Fuller's modification of it, group B streptococcal infections in the male appear to be uncommon.

At the Emergency Public Health Laboratory in Cardiff, during a period of fourteen months ending on January 31, 1941, a total of 1,283 strains of hæmolytic streptococci isolated from throat swabs of cases of acute upper respiratory tract infection were examined and grouped. Table IV shows that there was only one strain of group B

TABLE IV.—DISTRIBUTION ACCORDING TO GROUPS OF HÆMOLYTIC STREP-TOCOCCI ISOLATED FROM THROAT SWABS OF CASES OF ACUTE LUPPER RESPIRATORY TRACT INFECTION FROM 1,144 TO 3,1124 1.

OFFER RESE	ACCE CALL	INACI INFECT	TOTA T TOOLIS	TIVILIA P.	OX-LO-MA.
Streptococcal group	A	В	C	G	Total
No. of strains	114		96 7:48	38	1283

streptococci in the whole series and it was not considered to be of ætiological significance. There were no Group B organisms among strains of hæmolytic streptococci similarly isolated from the nasal passages of 83 subjects.

In milk-borne streptococcal infections in man due to *Str. pyogenes*, the opinion that the udder of cows may become naturally infected with hæmolytic streptococci of human origin was expressed by Savage (1911, 1931, 1937) and supported by Minett (1932, 1937), and Bendixen (1937). Confirmation was adduced by Bendixen and Minett (1938) whilst the demonstration by Pullinger and Kemp (1937) of the general failure of *Str. pyogenes* to multiply in fresh milk under normal conditions of storage gave indirect support to

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lst 105 to this view, and there is now a much wider acceptance of the view that milk-borne streptococcal outbreaks in man, which are widespread and persistent, are the result of udder infection. On the other hand the evidence (Allison, 1938; Henningsen and Ernst, 1939) suggests that explosive outbreaks of short duration or sporadic cases do result from direct infection of the milk from a human case or carrier.

The main reservoir of Str. pyogenes is the human throat and all udder infections of the cow with this organism may ultimately be traced to this source.

Smith (1939) resolves the control of milk-borne disease in general under three headings: (1) the control of disease in animals, (2) the control of infections and carrier conditions amongst the personnel engaged in the dairying business, and (3) pasteurization. Purely from the public health point of view Bendixen et al. (1937) strongly recommend that all liquid milk for human consumption should be pasteurized or boiled, and there seems to be little doubt that universal pasteurization, properly carried out, would lead to the disappearance of milk-borne diseases. Milkers and persons handling milk, suffering from acute infections of the upper respiratory tract, to which one might add septic infections of the skin and those with aural discharges, should be excluded until they are clinically well or found to be free from infection with hæmolytic streptococci and staphylococci. This compares with the current practice in human medicine of excluding midwives and maternity nurses suffering from an acute infection of the upper respiratory tract, sepsis of the skin or infective discharges, from contact with puerperal women, a practice which is now being gradually extended to other special hospitals and to general hospitals.

It is with some trepidation that I mention the use of face masks as an aid to the prevention of droplet infection of milk or the transfer of infection via face and hands The wearing of masks in human medicine has spread from the operating theatre to maternity practice, and is now being increasingly employed in surgical and otorhinological wards and in the dressing and treatment of war wounds. The dangers are inefficient masks and the development of a false sense of security, and the main difficulty would be that of prevailing on personnel to wear them, if such a recommendation were thought advisable. There is no doubt that the wearing of efficient masks intelligently used would reduce droplet infection to a minimum, and combined with disinfection of the hands, infection of the udder with group A streptococci could largely be avoided. Whether group A streptococcal mastitis is of sufficiently frequent occurrence to warrant such a step is doubtful.

It is interesting to note that the sulphonamides, even in large doses, appear to be without effect on the course of group B streptococcal infections in man.

Staphylococcal mastitis is of sufficient importance to merit some mention. There is still much to be learnt about the factors involved in the causation and spread of this infection, but human and veterinary medicine meet on common ground in regarding staphylococcal infection as of mutual interest, although from different angles. Staphylococcal food poisoning in man is not infrequently spread by milk, and follows not only the extraneous infection of milk, but also the excretion of enterotoxigenic staphylococci in the milk of cows with staphylococcal mastitis and even in the milk of apparently healthy cows. From the public health point of view pasteurization has been shown greatly to reduce the hazard, as the enterotoxigenic staphylococci are largely destroyed and fortunately the heat-stable enterotoxin is not preformed in the cow's udder. control mastitis in cows due to Str. agalactiæ must inevitably have a favourable effect on the incidence and spread of staphylococcal mastitis.

In conclusion it has been my duty to discuss bovine mastitis from the medical and public health aspect, but in doing so I am not unmindful of the different outlook of the veterinary profession on the subject. Any attempt to solve the problem must take both points of view into consideration and to this end co-operation of the medical and veterinary professions is essential, so that formulation of plans to control bovine mastitis shall not be resolved into control of the spread of group A streptococcal mastitis from cow to man via milk versus control of the spread of group B streptococcal mastitis from cow to cow. Plans to control the one must be complementary to plans to control the other and must be so drawn up as to gain the sympathetic co-operation of the farmer.

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Mr. S. L. Hignett: The treatment of mastitis especially that type arising from infection with Streptococcus agalactiæ (group B streptococcus).—It is now generally agreed that in most cases the eradication of Str. agalactiæ mastitis from dairy herds is not a practical proposition. Although some control can be effected by frequent testing of milk samples and arranging for infected cows to be milked last, insufficient is known of the pathogenesis of the disease to permit of eradication as a national plan. Research workers have shown that the previously accepted theory that infection is carried by the milkers' hands does not explain all cases; for heifers which from calfhood have not been in contact with milking cows have been shown to harbour the organism when they first calve down. For this and similar reasons many efforts have been made to supplement segregation by treatment of the affected animals.

In 1923 solutions of acridine dyes were first introduced into the udder via the teat canal. Early workers selected certain dyes, some preparations being found better for latent mastitis, others for clinical cases where the mammary secretion is changed in character. Recently entozon and acriflavine were shown to give 60% and 80% respectively of bacteriological cures in cases of latent mastitis when infused into the udder on two occasions at one week's interval.

Our programme included the introduction of antiseptic solutions (acriflavine, euflavine, dettol and quindoline methochloride (flaviquin)) into the udder via the teat canal, and the administration of sulphonamides by the mouth. Euflavine was made up in 4% lactose solution because it had previously been reported that even less mammary reaction was produced by a neutral acridine dye if used in a solution of lactose. In our experience there was no difference between the reaction obtained with euflavine in lactose solution and acriflavine in water. In all cases where udder infusion was employed the solution was made up in sterile distilled water, wherever possible all four quarters being treated. The udder was well stripped out and washed and 100 to 200 c.c. of antiseptic solution at body temperature were injected through teat syphons into each quarter and immediately stripped out. This was to wash out the galactophorous sinuses. Each quarter was then injected again until the tension was that normally present at milking time; it was then gently massaged. If the cow was in milk the solution was withdrawn after five minutes and the udder was stripped out several times during the remainder of the Milk secretion was suppressed for twenty-four hours and except when dettol was used the milk was discoloured for a further twenty-four to forty-eight hours after which it could be used. In the case of dry cows the solution was left in the udder for twenty-four hours and then removed. It was never possible after infusion to recover all the fluid injected. Since our aim was to evolve a practical and economical form of treatment, udders were infused once only. The trial of flaviquin was discontinued because of the severe mammary reaction following its use.

Where sulphanilamide was used it was administered orally, suspended in water, and the best results bacteriologically were obtained by giving an initial dose of 1 g. per 5 lb. body-weight followed by one-sixth of this dose every eight hours for five to seven days. The use of these quantities of sulphanilamide was often accompanied by diarrhoea, dullness, inappetence and reduced milk yield but these symptoms rapidly subsided when dosage ceased. Marked improvement in the nature of mammary secretion in many clinical cases was a feature of this line of treatment. (Such clinical improvement can be obtained with much smaller doses of sulphanilamide).

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It was found that the effectiveness of sulphanilamide varied considerably from one herd to another. More recently by the use of the ditch plate technique it has been possible to show that Str. agalactix from different herds possess a wide variation in their susceptibility to sulphanilamide.

A large number of cows were treated with a-ethyl sulphonamide which is highly soluble in water and diaminodiphenylsulphone which is insoluble. The percentage of bacteriological cures did not exceed those obtained with sulphanilamide but the diaminodiphenylsulphone which was administered in doses of 90 g, did not produce the untoward symptoms which were sometimes associated with sulphanilamide.

In a large number of cows in which the oral administration of sulphanilamide caused no permanent reduction in the streptococcal count, it was observed that there was a very marked decrease in the number of organisms present at about eight hours, after the large initial dose. It was therefore thought advisable to try the effect of such a single large dose followed, eight hours later, at the critical period, by udder infusion. Both acriflavine (1:10,000) and sulphanilamide (0.8%—a concentrated solution) were employed (see table).

Treated with		Administered				No. of cows	Average No. of quarters infected	Cows cured bac eriologically	Percentage	
Acriflavine			 via te	at canal			50	1.8	20	40.0
Euflavine		***	 via ter	at canal			40	1.8	18	45-0
Dettol		***	 via ter	at canal			19	2.6	5	26-3
Sulphanilamide			 per os		***	***	119	2.0	41	34.5
Sulphanilamide		***	 per os	and via	teat car	nal	42	1-5	13	31.0
Sulphanilamide	and	acriflavine	 per os	and via	teat ca	nal	43	1.4	22	51.2
C	merc	ale	-				6162	0.1	4	5.0

At the present time a controlled experiment is being undertaken to determine the value of vaccines in the prevention and treatment of Str. agalactic mastitis

value of vaccines in the prevention and treatment of *Str. agalactiæ* mastitis.

Attention has also been given to "summer mastitis" (*Corynebacterium pyogenes*), staphylococcal and Group C streptococcal mastitis. The first two have been treated by serum and toxoid respectively. The use of these products appears to save the cow but not the affected quarter. Cases of Group C streptococcal mastitis are rapidly cured both bacteriologically and clinically by the use of sulphanilamide, whereas formerly the affected quarter was always lost. Cases of mastitis due to *Str. dysgalactiæ* would also seem to benefit by the oral administration of sulphanilamide.

Dr. Robert Cruickshank thought the factors predisposing to bovine mastitis and lactation mastitis in the human might be similar although the predominating causative organisms were different. In the examination of breast-milk from puerperal women he had found that Staphylococcus aureus was present in numbers up to 100,000 per c.c. or more in over half the cases without being associated with any clinical infection. Infection when it occurred seemed to be correlated with inadequate emptying of the breast. The cracked nipple, a common precursor of mastitis, was a contributory factor, not because it facilitated passage of the infecting organism, but because it caused pain to the mother during suckling with the result that the corresponding breast was not properly emptied; similarly, engorged breasts were sometimes the precursor of mastitis. The infecting organism in the human was probably often derived from the infant's nose as over 90% of infants were nasal carriers of Staph, aureus, so that the organism could be aspirated into the milk-ducts by back-suction. The hands of the milker were the most likely vehicle of the infecting organism in bovine mastitis; if so, prevention of spread should not be impossible.

Mr. H. W. Steele-Bodger said that Dr. Stableforth had not mentioned the condition known as "Black Spot", which was very prevalent. In the past most of these cases had resulted in the loss of a quarter but since Mr. Hignett had informed him that it was frequently due to Str. agalactiæ they had used sulphonamide therapy with great success. Dr. Stableforth had mentioned the value of filling the teats of dry cows with an antiseptic emulsion and he would like to emphasize the success of this preventive measure. He also confirmed Mr. Hignett's evidence concerning the variation in results which were obtained from the use of sulphonamide on different farms.

Dr. H. J. Parish: Mr. Hignett's communication has suggested to me once again the necessity for state aid if the control of diseases of cattle is to be really effective. It is useless to expect the farmer to find the money for expensive prophylaxis and treatment. Staphylococcal mastitis has been influenced to some extent by toxoid, but the results

are not uniformly successful, for the immunity produced is antitoxic and not anti-bacterial. In laboratory animals, injections of staphylococcus toxoid or of antitoxic serum may save the lives of rabbits or mice, but will not entirely prevent abscess formation.

Mr. John Francis: It is difficult to isolate Str. agalactiæ from any site in the animal body other than the udder. On the other hand Str. dysgalactiæ, Str. uberis, group C hæmolytic streptococci, staphylococci and C. pyogenes can all be fairly frequently isolated from the nasopharynx and from the vagina. It thus appears that there is some essential difference in host relationship between Str. agalactiæ and the other organisms which produce mastitis.

It is now recognized that light infection with Str. agalactiæ may be transient and it appears that if sufficiently stringent cultural methods were applied frequently enough that almost every cow would be found to harbour infection at some time or other. For the purposes of control it would therefore seem necessary to define what is to be accepted as

an infected cow.

**Mr. D. L. Hughes** said that the control of streptococcal mastitis based on the old concept, that *Str. agalactiæ* was a strict parasite and the infected udder the only reservoir, would break down.

There were a number of facts which needed emphasizing, including the widespread distribution of the organism, the relative frequency with which it could be recovered from the external surface of the udder of apparently uninfected cows and the ease with which it could be recovered from the hands of milkers between milking. Confusing results had been obtained from regular testing of the milk of cows in herds under good management and the more frequent the tests and the more drastic the technique, the higher the number of cows found to be infected. The irregularity of the excretion of the organisms in the milk in those cows without clinical symptoms was also important.

Was there any justification for elaborate schemes of control and eradication which

had so many technical pitfalls?

Mr. Hignett had mentioned the testing of the susceptibility of strains of *Str. agalactiæ* to sulphanilamide by the blood agar ditch technique, in parallel with the clinical treatment of the animal with the same drug. Doubtless many of the disappointing results obtained with this and related compounds could be explained by the resistance of the infecting strain to the action of these drugs and much time, money and labour could be saved by such a preliminary, simple *in vitro* test with the drugs in question, before treatment of the animal was undertaken.

Finally, he would like to see much more extensive research work on treatment with numbers of old and new chemotherapeutic agents. It was likely that with all the drugs we already knew of and many yet to be tested, most cases would yield to one form of treatment or another.

Research on infection in the animal as a calf, although it would be of a protracted and rather expensive nature might yield results of some importance.

Dr. A. D. McEwen said that he and J. D. Paterson had treated twenty to thirty cases of mastitis by the infusion of sulphonamide E.O.S. 2.5 and 5% solutions had been used for cows in milk and 5 and 10% solutions for cows whose udders were dry or in the process of being dried off. The results were encouraging, a marked clinical improvement rapidly being obtained. The treated quarters might or might not be sterilized but if the clinical improvement was maintained, the persistence of a Str. agalactiæ infection might be of little significance, as a high percentage of clinically healthy cattle excreted Str. agalactiæ in their milk.

He agreed with Mr. Hignett that 4:4'-diaminodiphenylsulphone when given by the mouth was better than sulphanilamide. Therapeutic doses of the former product appeared to be completely non-toxic for cattle. They had treated acute cases of Str. agalactiae mastitis by giving 4:4'-diaminodiphenylsulphone by the mouth for three to four days, and when the acute symptoms had subsided, infusing a solution of sulphonamide E.O.S. into the still clinically infected quarters.

They had tried the effect of infusing 4:4'-diaminodiphenylsulphone into the udders of normal cows but up to the present they had been unable to obtain a suspension or a solution that was sufficiently non-irritant to warrant this method of treatment in cases of mastitis.

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Mr. S. J. Edwards said that results achieved in the control of streptococcal mastitis were directly proportional to the efforts made by the farmer and his staff. Where bacteriological testing of milk samples was regularly carried out and proper hygienic precautions adopted the incidence of infection was reduced. In order to achieve this state complete segregation of infected animals, together with the practice of washing the udders of cows with water containing antiseptic and effective sterilization of milkers' hands between milking were necessary.

With regard to the chemotherapy of the disease, recent work carried out by Dubos and by Dubos and Little, on the use of gramicidin appeared to offer a promising field. This substance had been shown to possess highly bactericidal action on streptococci and in vitro it could be demonstrated at a dilution 1:1,000,000. The injection of gramicidinoil suspension in the cow's udder appeared to cause much less irritation than the injection of substances in large amounts of aqueous solution such as had been tried hitherto.

Dr. J. T. Edwards (Pirbright) said he still felt that the ætiology of the common forms of bovine mastitis could not be completely explained in terms of the common type of streptococcus found in the milk drawn from affected udders. Points against its acceptance as the sole cause were: firstly, the difficulty of setting up the disease artificially in a normal udder unless certain drastic steps were taken to introduce the streptococci into the udder cistern; and, secondly, especially when enrichment methods were employed to detect very small numbers of streptococci in the milk, the frequent finding, as had recently been exposed particularly by the results of the Australian workers (Munch-Peterson et al., 1940), of streptococci in the secretions of udders that were not visibly diseased, their transitory appearance in small numbers in the milk of some cows, and their appearance even in the udder secretions of young heifers.

Although difficulty had been experienced in transmitting the disease artificially with cultures of the streptococcus, this did not necessarily exclude its playing the role of the most important pathogen in the series of steps leading to the occurrence of natural bovine mastitis. It was not unlikely that although the common streptococcus of bovine mastitis had a distribution that was almost ubiquitous in some localities, it might be raised in virulence, given certain circumstances which favoured its spread and multiplication, from that of a harmless commensal to that of a true pathogen.

Not all diseases of animals in which streptococci could be cultivated in pure culture from the lesions were now universally accepted as caused primarily by these organisms. Both in strangles and the common equine pneumonia, especially the latter disease, there was some experimental evidence on record, from work done in Germany before the last war, pointing to a virus as the primary causal agent. There was some American work, pointed out by Dr. Stableforth, reporting the presence of a virus in cases of "non-specific mastitis" in cattle (Broadhurst et al., 1939), but the work needs to be confirmed.

Recently, much suggestive information had been forthcoming from studies upon the condition known as "chronic mastitis" in women. In this condition, there was usually no bacterial infection. The subject had been discussed editorially in the Lancet (1940 (ii), 423), and he was surprised that day to find Dr. Cruikshank state that in "lactation mastitis" in women, a condition which appeared to follow injuries to the teats and mammary gland, staphylococci were found in the lesions. The "chronic mastitis" on the other hand is a condition which appears to be quite different and commences about seven to ten days before the menstrual flow when the œstrogen content of the blood is at a maximum and there is strong evidence that the condition is due to an excess of œstrogens, and can be alleviated by appropriate hormone therapy. In the modern highyielding dairy cow it was to be anticipated that disturbances of a similar order were not unlikely to arise, caused by irregularity in the ebb and flow of œstrogenic and mammogenic hormones during the evolution and involution of the mammary tissues, and subsequently, it could be argued, in localities where the common streptococci of bovine mastitis were ubiquitous the "soil" would be provided for its ready implantation. There was now a good deal of American evidence on record showing that a "non-specific mastitis" does exist in dairy cows, in which no streptococcal or other bacterial infection has gained a foothold, and the hypothesis has already been advanced by Peterson and Hastings (1939) that the common bovine mastitis is the product of two factors, namely, a lowering of resistance due to "non-specific mastitis" followed by streptococcal infection (Francis, 1941).

Some suggestive work had been published a few years ago by German workers (Stang

et al., 1937; Witt, 1936), alleging that the incidence of mastitis ran parallel with the degree of feeding of dairy cattle with imported concentrates such as oil cakes, &c.—so much so that the workers recommended the feeding of cows on pasture and with homegrown produce only, suggesting that the high protein content or other deleterious ingredient of the imported concentrates produces a preliminary irritation of the udder tissue.

The success in specific therapy need not however be adduced as evidence that the

streptococci were alone responsible for the disease.

It was not unlikely that in selective breeding—a process which, fundamentally, it now seemed, is one which contrives to modify in a given direction the hormone balances of the body—it might eventually be found more profitable to evolve a type of cow which was perhaps of lower milk-yielding capacity but not so prone to irritative disturbances in the very labile tissue that was that of the mammary gland in the course of its physiological evolution and involution.

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- Dr. A. T. R. Mattick (National Institute for Research in Dairying) said that it would be foolish to deny the possibility of a virus being involved in mastitis but recounted his experience in herds which he believed to be virtually free from mastitis (Str. agalactiæ). Cows had been removed from herds if the milk was found to yield, from the quantity examined, even one streptococcus and it was now difficult by a stringent technique to show that infection, however light, existed. The position was that injuries to the udder, although as frequent as formerly, did not now terminate in mastitis. In infected herds it was common knowledge that injuries were as a rule followed by mastitis. It was therefore perhaps a fair inference to say, in respect of contagious streptococcal mastitis, "No Str. agalactiæ—no mastitis".
- Mr. J. R. Barker said that the discussion had brought to the front the relative position of the parasitism of the invading micro-organisms, the resistance of the dairy cow and certain other unknown factors including the possibility of a virus. Investigations should be made on the bacterial flora of the udders of beef cattle which suckle their own calves. So far he had not found the Str. agalactiæ in samples from this class of animal but Corynebacterium pyogenes and a staphylococcus were frequently encountered in the same sample taken from an affected quarter.
- Dr. Stableforth (in reply) said that the value of formalin might be assessed by submitting samples for laboratory examination before and after treatment and correlating the results with the clinical findings. They would be pleased to co-operate in any work of this kind. In regard to human infections with group B strains he had made a serological examination of some 18 strains sent him by Dr. R. Hare some years ago and had found that none belonged to any of the serological types commonly found in bovines in Great Britain. Str. agalactiæ had not been recovered from the noses of adult bovines and there was no evidence that it occurred in calves, all the evidence still suggested that the main source of infection of the udder was via the teat. The reminder that he had made no mention of so-called "black spot" on the teats was timely; further study of the condition might well be profitable. Whilst Str. agalactiæ would live outside the body for a considerable time, there was no evidence that it could multiply there. Various solutions had been tried as vehicles for the bactericidal agent for udder injections and there was some disagreement as to their relative value. They had had better results with distilled water than with vehicles such as lactose solution, which had an osmotic pressure more like that of milk.
- Dr. V. D. Allison (in reply) said he had hoped to hear from the veterinary profession some data regarding the incidence and importance of mastitis caused by Str. pyogenes (group A), the chief organism which was a cause of bovine mastitis and was also directly inimical to man. From the lack of reference to it in the discussion he gathered that it was rather uncommonly met with and not of importance as a disease-producing agent in cattle.

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## [April 15, 1942]

## Brucellosis and Sterility

Mr. George N. Gould: The control of bovine brucellosis presents many difficulties which are accentuated in war time by the need for the greatest possible production of milk and the restriction of pasturage brought about by the "ploughing up" policy. The ideal solution is agreed by all: the eradication of the disease by early detection of infected animals and the removal—preferably by slaughter—from the herd. As a practical policy in this country I believe it to be impossible of attainment. With this aim in view the United States Bureau of Animal Industry started a scheme for the eradication by agglutination testing of individual herds followed by area testing, and slaughter of reactors—the owners being indemnified—as part of the political policy to reduce the number of cattle in the depressed dairying industry of the U.S.A. in 1934.

Mohler et al. (1941) records that in the seventh year of the scheme the cost to America was nearly 7,500,000 dollars and that there were then 61,654 state accredited herds containing 1,114,191 cattle; between 1934 and 1938 1,596,554 cattle were slaughtered or eliminated as reactors. Once eradication had been effected the Americans found, as individual owners and veterinary surgeons had in this country, that the maintenance of the herd free from infection was extremely hazardous, and necessitated the most rigid control of movement, transport and purchase which could not be effected other than by area and actual state control.

In spite of the success claimed the department decided to approve a plan to incorporate the vaccination of calves as an adjunct to eradication. With this end in view large-scale field experiments have been carried out using strain 19, an attenuated vaccine produced by Buck in 1925 which had been found to give a serviceable immunity when injected into cows and heifers but, unlike fully virulent cultures, did not become residual in the udder, did not establish infection in the herd and did not become virulent by passage.

Mohler et al. (1941) reports the field trials carried out between 1936-1940 in which 17,000 calves were vaccinated at the age of 5-7 months many of which had subsequently passed up to four pregnancies, 96·2% of parturitions were normal, 3·8% ended in abortion, 82·9% of those which calved normally were negative to a post parturition test, 5·1% positive, and 12% suspicious. Of the 3·8% which aborted 58·7% were negative to post-parturition test, 31·9% positive and 9·3% doubtful. On the basis of the agglutination test only 1·6% of abortions could be attributed to brucellosis. The incidence of natural infection in these herds as revealed by the test at the commencement of the trial was 5,531 (29·2%) and of these reactors 24·1% were still in the herds in July 1940, thus exposing the vaccinated animals to severe natural infection.

In England Dr. McEwen has produced a vaccine Wye No. 2, which, while it gives a highly serviceable immunity, does not produce a reaction to the agglutination test. This vaccine has been utilized under field conditions and in my experience the results are satisfactory. The vaccine is injected into empty cows and heifers and immunity is reinforced annually.

In this country the average incidence of the disease is, without question, much higher than that met in the U.S.A.

In the near future a voluntary scheme is to be introduced, sponsored by the Ministry of Agriculture, in which vaccines of standardized virulence issued by the Ministry will be utilized to effect some control of this disease. The vaccine will be injected into non-pregnant animals of all ages and one type will be suitable for calfhood vaccination.

It is realized that prevention of infection is more important than prevention of abortion, which is only a symptom of the specific endometritis produced by the disease. It is quite clear that vaccines have no curative effect. In early times fully virulent vaccines as recommended by the British Board of Agriculture in 1916 were used, often with a considerable degree of success, to reduce abortion in infected herds. It has been shown that in many instances, such a procedure is followed by localization of the vaccinal organism in the udder and that inoculated animals were thus made chronic carriers of the disease and secreted the organism in the milk. Fully virulent vaccines have, from time to time, being vigorously condemned as being responsible for the introduction, maintenance and spread of the disease, in all countries.

A disquieting feature of official omission in this country is the failure to control veterinary biological products. This applies particularly to vaccines for contagious abortion.

I am convinced that vaccination with an approved, attenuated vaccine of standardized virulence, is the only practical policy that can be applied in this country for the control of this disease, combined with suitable educational propaganda to obtain those methods of improved herd management necessary to minimize the frequency and danger of exposure to infection.

The incidence of brucellosis of man has been stated to be on the increase in recent years and has been estimated at 11 per 1,000,000 per annum. This figure is probably much lower than the true incidence owing to undiagnosed cases and the probable large

number of ambulatory or mild cases.

The alleged increase may be accounted for by more frequent diagnosis than in the past but a more difficult point to explain is the low incidence claimed when it must be admitted

that Brucella abortus is very commonly present in milk.

The importance of *Br. abortus* is not only its possible transmission to man but the tremendous loss of milk caused by bovine infection estimated in the report of the Survey Committee of the N.V.M.A. on Diseases of Farm Livestock (1940) at 40,000,000 gallons per annum. Further factors are the loss of calves and the large incidence of temporary infertility and sterility which is a sequel of infection—whether the animal aborts or not.

The loss of calves is of very great moment for it is essential that our dairy herds be increased to maintain milk production, to maintain the fertility of the soil, to provide adequate replacements for the dairy herds in the future and to be ready for the restocking of the Continent when the war ends. This can best be accomplished by a vigorous policy of disease control with special attention to breeding efficiency and milking capacity.

The loss of milk due to sterility has been estimated at over 100,000,000 gallons per

annum

It is accepted that endometritis of varying degrees is responsible for at least 80% of infertility and sterility in dairy cows, and that about 50% of cases are the sequel of Brucella infection. Cervicitis and vaginitis are common complications. The majority of these cases are first degree endometritis and respond readily to a single intra-uterine injection with an appropriate preparation such as aqueous solution of iodine 1:1,000 to 1:500. More serious cases may require repeated treatment, but, except where gross lesions are present as in pyometra or salpingitis, 70 to 80% recoveries can be obtained.

In the last few years there has been a gradual increase in the incidence of *Trichomonas* fætus infection and Str. pyogenes infection of the uterus. Both are venereal diseases transmitted by the bull, and are responsible, in individual herds for serious interference with breeding efficiency, heavy loss of milk production and loss of calves. Both conditions respond to efficient treatment by intra-uterine injection and control measures of breeding

hvgiene.

The treatment of pyometra, both specific and non-specific, has been greatly expedited in those cases where it is not possible to enucleate the corpus luteum, by the use of stilbæstrol dipropionate—the synthetic æstrogenic product—following the suggestion of Brownlee and Montgomerie (1941).

Physiological derangement accounts for about 10% of all causes of sterility in average herds; the incidence due to this cause being higher in certain intensively managed farms.

Good herd management and full co-operation of the farmer are important factors in the control of sterility. Records of (1) dates of œstrus; (2) dates of service; (3) dates of parturition; and (4) service records of bulls, are of great assistance in the diagnosis of pregnancy, particularly in the early stages at seven to nine weeks, and in facilitating diagnosis of the cause of infertility where it exists. The service record of the bull is particularly useful in indicating loss of fertility at the earliest possible moment. These records enable cows showing abnormality in the length of the æstral cycle to be withheld from service. Cows showing abnormal vaginal discharge, whether at æstrus or between æstral periods, should be similarly treated. With either of these manifestations it is practically certain that the cow will not conceive, and repeated service often appears to accentuate the abnormality.

Dietetic errors likely to influence sterility can be remedied by the provision of mineral or other supplements. "Silent heat" can usually be overcome by ovarian manipulation. Anterior pituitary hormone preparations and stilboestrol have their respective uses in

appropriate cases of physiological sterility.

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To control infertility and sterility a system is required to facilitate regular periodic veterinary examination of cows and heifers to permit pregnancy diagnosis and prompt treatment when necessary; the infertile period would thus be made as short as possible, avoiding losses due to long dry periods, maintenance while the animal is unproductive and reduced annual milk yields.

In my experience 80% of affected cows are curable provided early and appropriate treatment is given.

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Dr. A. S. Parkes: Biological aspects of sterility.—Fertility in mammals may be taken to mean the capacity to give birth to living young. Conversely, sterility may be taken to indicate inability to do so. Fertility in any vertebrate, and especially in mammals, is the result of a long chain of physiological processes. Breakdown at any link results in failure to produce living young. Three main phases are involved: (a) The production of functional gametes, that is to say ova and spermatozoa; (b) fertilization; and (c) successful gestation of the embryo. Sterility is often classified according to the phase at which failure occurs: Primary sterility—failure to produce functional gametes; secondary sterility—failure to effect fertilization; tertiary sterility—failure to effect gestation.

The failure to produce functional gametes is associated with some abnormality of the testis or ovary, and is usually due to some genetic, anatomical, endocrine or metabolic cause. So far as farm animals are concerned, the condition is more often met with in the female than in the male, especially in those species in which the female has an ancestrous period during which ovarian activity ceases. From our present point of view, the endocrine aspect of gametogenesis is of some interest since it now seems to have been conclusively shown on experimental animals that gonadotrophic activity on the part of the anterior pituitary body is required for normal functioning of the gonad and that the administration of gonadotrophic preparations can produce ovulation or spermatogenesis in a gonad which would otherwise be quiescent.

Failure to effect fertilization when normal ova and spermatozoa are produced is usually to be found in some congenital or acquired abnormality of the accessory reproductive organs, notably of the reproductive tract. In farm animals this condition is more often found in the female than in the male, and may be associated with blockage of the reproductive tract at some point, or with a physiological condition of the mucosa of the tract or of its secretions deleterious to ova or sperm.

Many causes of failure to effect gestation are known. There may be failure to implant the fertilized egg; death of the embryo or fœtus, or failure of placental function; at the last moment the birth mechanism may fail. Many of these disturbances are non-endocrine in origin, but I propose to deal only with the endocrine aspects.

The act of ovulation is preceded by the follicular phase of the ovarian cycle, during which a graafian follicle grows to maturity and the reproductive tract is stimulated by cestrogenic hormones produced by the ovary. After ovulation, the corpus luteum grows from the shell of the ruptured follicle and secretes a specific hormone, progesterone, which prepares the uterus for the reception of the fertilized ovum. This preparation always includes the induction of a physiological sensitivity which enables the uterus to produce decidual tissue in response to the presence of the fertilized egg. In many species it is also characterized by extensive morphological proliferation of the endometrium. In every species examined it has been shown that the successful implantation and development of the early embryo is entirely dependent on the presence in the ovary of one or more corpora lutea, and, therefore, failure to develop a functional corpus luteum after ovulation causes sterility. The development of the corpus luteum is almost certainly controlled by the luteinizing hormone of the anterior pituitary body, and deficient activity of the pituitary body thus leads to non-development of the corpus luteum after ovulation. This sequence of events is easy to produce in experimental animals, but otherwise the

pituitary body rarely seems able to initiate the changes leading to ovulation without being able to support the subsequent growth of the corpus luteum.

Although the corpus luteum is necessary for the very early stages of pregnancy the degree to which it is essential during the later stages appears to vary in different species. In mice, rats and rabbits, removal of the ovary, or even of the corpus luteum alone, at any stage of pregnancy, appears to be fatal. In the guinea-pig the corpus luteum can be removed with impunity during the later stages of gestation. In women there are authentic records of pregnancy having been completed after removal of the corpus luteum as early as the end of the second month of pregnancy. In cows most observers are agreed that removal of the corpus luteum during pregnancy results in abortion. Morphological atrophy and therefore, presumably, decline in the physiological function of the corpus luteum at some stage or other of pregnancy, always seems to precede birth of the young.

At this point I must say a further word about the rôle of the pituitary body in pregnancy. Since hypophysectomy leads to atrophy of the ovary, one would expect hypophysectomy to be fatal to pregnancy in much the same degree as ovariectomy. In the early stages this appears to be the case, but in the later stages the situation becomes confused, apparently by the intervention of the placenta, and the pituitary body seems to decrease in importance so far as the maintenance of pregnancy is concerned. Its presence, of

course, is essential for the initiation of lactation at birth.

The endocrinology of the placenta is extremely complicated, and the precise rôle of the organ in maintaining the endocrine balance necessary for successful pregnancy is not yet certain. There can, however, be no doubt that endocrine activity by the placenta plays a very important part in the close integration of ovaries, anterior body, and conceptus, and new researches are continually emphasizing this importance. The evidence has been derived from two types of experiment—extraction of active principles from

placental tissue, and operative interference during pregnancy.

Several of the sex hormones are found in the placentæ of one or other species. Thus cestrogenic substances appear in abundance in the placentæ of several species, notably in man and in cattle. The significance of the presence of these substances is obscure, as also is their source of origin. The fact that in several species administration of cestrogenic hormones during pregancy results in abortion or reabsorption of the embryos puts a teleological difficulty in the way of supposing that cestrogens are elaborated in the placenta. On the other hand, it has been shown that under certain conditions, and in appropriate dosage, cestrogens have a stimulating effect on the corpus luteum, as well as a general growth-promoting effect on the reproductive tract, and may therefore have an essential function during pregnancy. Moreover, cestrogen has been found in the placenta in man after a pregnancy carried through in spite of the removal of the ovaries at an early stage; in this case the placental cestrogen can hardly have been of ovarian origin. Progesterone, which one might expect to be produced in the placenta, especially in species in which the corpus luteum does not seem to be necessary for the whole of gestation, has been found only in very small amounts and only, I think, in the human placenta. Gonadotrophic substances have also been found in the placenta, but only apparently in women and mares.

As regards operative interference, removal of the whole conceptus, fœtus and placenta, at any stage in pregnancy, invariably leads to the disappearance of all signs of pregnancy and to the return of the œstrous cycle if the animal is still in the breeding season. Removal of the fœtuses alone, however, in experimental animals at any rate, does not necessarily have this effect. Where the placentæ are left uninjured gestation proceeds for a certain period with all the usual signs, and the placentæ may even be delivered at the normal time. In the mouse, this happens even if the pituitary body is removed with the fœtuses. In the cat, ovariectomy causes death of the fœtus, but the placentæ continue to grow normally for several weeks. In the rat, ovariectomy can be performed without disturbing the pregnancy provided that the fœtuses are reduced to one, and all the placentæ left in position. This evidence indicates that the maintenance of pregnancy

and the initiation of birth are at least partly controlled by placental activity.

It is thus easy to see that damage to the placenta, even if not sufficiently severe to destroy its metabolic functions, might well inhibit its endocrine activity sufficiently to make continued gestation impossible. This contingency must be considered seriously in any discussion of the mechanism whereby infection of the placenta leads to abortion.

Dr. John Hammond: Sterility in cattle.—First let us consider sterility in cows from the farmer's point of view in war time. Each year he has to dispose of some cows from his

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herd and replace them by others. In war time these replacements are expensive, for the food used to rear them could be much more profitably fed to animals producing milk. Over 20% of the cows leaving herds each year do so because of sterility (Wright, 1933). Much of this sterility is of a temporary nature.

The position of dairy farmers is that while the consumption of milk reaches a peak during the early winter months, it is at this time of year that the production of milk is at its lowest in herds in which an equal number of cows calve each month (Sanders, In order to have sufficient milk from November to January, therefore, it is necessary to have a high proportion of the cows in the herd calving from September to Figures taken from Milk Recording Societies (Hammond, 1927) show December. that this is far from being the case, especially among the more Northern Counties. Thus in Cumberland only 4.6% of the cows calve in October, whereas 21.2% of the cows calve in March. If the interval between calving and fertile service is calculated the cause for this is seen. In four Milk Recording Societies the average number of days between calving and fertile service was 97 (at 85 days they calve on the same day in the following year). Those cows which calved in September and October, however, went over thirty days beyond the average time before getting in calf again, while at the other end of the scale cows calving in April and May manage to get in calf again about twenty days under the average time. Again, there is evidence that it is more difficult to get autumn calvers in calf again during the winter in the North than in the South; October calvers go forty-eight days over the average time in Cumberland, whereas in Somerset they only go twenty-one days over the average. There is thus, as Roberts (1929) has shown, a tendency for cows to get round to spring calving as they get old; for example, of 1st calvers 17%, of 3rd calvers 35% and of 6th calvers 42% calved in March, April and May. The result of this temporary sterility during the winter months is either that the farmer has to dispose of cows which are not due to calve at the right time of year, and increase the cost of upkeep by replacements, or retain cows in the herd for some time in an unprofitable dry condition. Under present war-time conditions and the high price of down-calving cows in the late autumn the farmer is tending to retain more animals in this unprofitable dry condition during the winter and so reduce the winter milk supply.

To obtain down-calving heifers and cows from August to December it is necessary for the heifers and cows to be got in calf from November to March. It is therefore during these months of the year that the veterinarians should be particularly busy with the early diagnosis of pregnancy and the treatment of those cows which are found not to be pregnant.

Throughout these winter months where, particularly in the northern part of the country, the cows are housed and fed on dry feeds, as distinct from grass or succulents, there is difficulty in getting the cows to breed as compared with the summer months when they are out at grass. In the wild state cattle calve in the spring months, which means service from May to July, and it would appear highly probable with our knowledge of what happens in wild animals with seasonal breeding periods that the fundamental cause of the low breeding activity during the winter months is the relative inactivity of the anterior pituitary gland in producing the follicle-stimulating hormone during this season of the year. This inactivity may express itself in varying degrees in different animals (just as some hens are good winter layers and others not) and so there are various degrees of sterility and modes of expression.

In those animals with the most marked inactivity the ovaries go into anœstrus and no follicles at all are ripened. This condition is particularly liable to occur in young animals, heifers in poor condition or in first calvers which have been milking heavily. It is more frequent too in the North where the cattle are housed than in the South where feeding conditions are better. Bhattacharya, Hammond, Jnr., and Day (1941) have shown that injections of 1,500 I.U. of the follicle-stimulating hormone of pregnant mare serum, or of horse pituitary gland, will under these conditions cause follicles to ripen and heat to occur together with conception if served. These injections are the most effective way of dealing with anœstrus cows but I would stress the importance of examining the ovaries to see that the cow really is in an anæstrus condition before the injection is made—for otherwise, if there is a young corpus luteum present in the ovary, there is the danger that cysts may be produced, or if there is a mature corpus luteum in the ovary, that two or more eggs may be shed at the next heat period and so twins, triplets or more produced. In cows treated in this way Hammond, Jnr., and Bhattacharya (1942) have obtained up to 30 eggs shed at a time and have produced triplet calves.

In animals with rather more gonadotrophic activity during the winter months there

may be ovulation and the formation of a corpus luteum but no heat, or a very short heat. With heifers therefore it is preferable to run them with the bull rather than to rely on individual matings: if this system is followed it is desitable to make pregnancy diagnosis periodically and remove the heifers known to be pregnant. The animals with "silent heats" (corpus luteum without heat) can be treated by squeezing out the corpus luteum and throwing over the cycle to the follicular phase at shorter intervals than normal. This will usually be sufficient to cause heat. Other animals, especially older cows, appear to ripen their follicles so slowly that large cysts are caused. Day and Hammond, Jnr. (1942), have shown that such cysts can be caused experimentally after the ovary has been thrown into the anæstrous condition under the influence of stilbæstrol and before the gonadotrophic hormones have got going again and the normal cycle has been resumed.

In animals with only slightly subnormal gonadotrophic activity during the winter months the normal recurrence of heat and ovulation is not interfered with, but conception is rendered difficult and the animals return frequently to the bull. It would appear probable that in these cases the changes occurring during the cycle are unbalanced in the direction of the luteal phase, for removal of the corpus luteum at an early stage (eighth to twelfth day) of the cycle, which shortens the cycle and throws it over to the follicular phase, is followed by fertility in a high proportion of cases (Hammond, 1939).

The variation in sperm production among bulls probably follows the same course as the variation in fertility in cows (Walton, Edwards and Hammond, 1940). We do not know enough yet about the effects of the hormones on sperm production to be able to treat sterile bulls. The best course we can adopt under the circumstances is to test the semen by means of collection with the artificial vagina (Walton, 1938) and use only those

bulls which are fully fertile.

Cases of sterility in cows which occur with much the same incidence at all times of the year I shall not deal with in detail, as these are mainly pathological in character such as pyometra, cervicitis, &c. I would, however, say in conclusion that Day (1942) has found injections of stilbæstrol to be very effective in raising the tone of the uterus and in causing dilatation of the cervix so that discharges are evacuated and the condition clears up.

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Professor G. S. Wilson, referring to the incidence of undulant fever in Great Britain, said that in 1932 he had attempted to estimate the annual number of cases by an indirect method depending on the proportion of sera from patients with pyrexia of unknown origin that contained agglutinins to Brucella. Figures collected from eight laboratories in Great Britain and Ireland showed that 3.5% agglutinated Br. abortus to a titre of 1:80 or over, and that 21% agglutinated organisms of the typhoid-paratyphoid group to a significant titre. Since there were 2,899 cases of enteric fever reported in England and Wales in 1930, it was concluded that the number of cases of undulant fever in relation to these was in the ratio of 3.5:21, or about 480.

More recently, Dr. Messer of the Northumberland County Laboratory had analysed his figures for the years 1930 to 1941 and had very kindly given the speaker permission to quote them. Of 1,190 sera, 3.4% agglutinated Br. abortus to a titre of 1:125 or over and 23.9% agglutinated organisms of the enteric group. These percentages so closely resembled those found in 1932 for the country as a whole that there seemed no reason to alter the previous estimate for the incidence of undulant fever cases in England and Wales, namely about 500 a year.

In collaboration with Dr. Robb-Smith of the Radcliffe Infirmary he had been trying to repeat the findings of certain American authors who had isolated Brucella from the lymph nodes of patients suffering from Hodgkin's disease. Material from 15 cases had been examined so far with completely negative results.

In collaboration with Professor Seddon of Oxford he had been examining the frequency of agglutinins to Brucella abortus in the sera of patients in orthopædic hospitals to find

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out what proportion of bone and joint lesions were due to infection with this organism. Of 496 sera examined less than 1% contained agglutinins in a titre of 1:80 or higher. Examination of the clinical records was not yet completed, but it seemed justifiable to conclude that Brucella infection could not be responsible for more than a very small proportion of bone and joint lesions. Reference was made, however, to a case some years ago of acute osteomyelitis in a child of 2 years of age from whom Dr. Panton had cultured Br. abortus. The child had been given raw Certified milk from a herd in which several cows had recently aborted. Br. abortus was isolated from the milk of a number of the cows. The strains all resembled the strain isolated from the bone abscess in the child in growing under ordinary aerobic conditions on primary culture.

Dr. S. J. Folley: I do not find myself in complete agreement with Dr. Hammond's statement that pregnant mares' serum is always the hormone of choice for inducing heat and ovulation in ancestrous cows and heifers. The experiments of Steinach, Stäheli and Grüter showed in 1934 that cestrus and ovulation could be induced in many cases of ancestrus in cows and heifers by an injection of cestradiol monobenzoate. In a limited series of experiments with cestradiol esters we have successfully induced the resumption of ovulatory cestrous cycles in a good proportion of ancestrous bovines. There is no reason why the cheap synthetic cestrogen, diethylstilbæstrol, should not give similar results and, in cases where cestrogen treatment might be expected to cause a resumption of cestrous cycles, the use of synthetic cestrogen would be preferable to pregnant mare serum on the score of low cost.

Contrary to Dr. Hammond's results, in our experiments on the effect of pregnant mare serum on the bovine ovary, we have hitherto found no relation between the phase of the estrous cycle at which the injection is made and the number of ovulations resulting from the injection.

Lastly, with regard to sterility in bulls, through the kind co-operation of veterinarians, we have had an opportunity of doing experiments on a few bulls giving sperm with low motility (measured by the rate of oxygen consumption) and in three cases found that treatment with chorionic gonadotrophin (pregnancy urine extract) has resulted in an improvement in the motility of the sperm and in the breeding performance of the bull. This would merit further investigation.

Mr. H. W. Steele-Bodger was impressed with the high incidence of *C. pyogenes* infection in certain herds; in these herds there was a tendency to early salpingitis; in one such herd, out of 14 dairy cows examined, 12 were barren, 10 of them had not calved for two years and were nearly dry, and 8 would be permanently sterile. He would like to emphasize the value of stilbœstrol in the treatment of pyometra; this product had also been used with success in the treatment of acute metritis in conjunction with sulphanil-amide which was introduced into the uterus mixed with antiseptic soft soap. Stilbæstrol had also been used with success in retention of placenta.

Mr. Hignett had reported that after the removal of the corpus luteum at four months, a cow had carried her calf to term. He understood that stilbœstrol was supposed to have no effect upon the pregnant uterus, but he knew of two instances where an injection of stilbæstrol had been followed by abortion in two or three days.

He had been struck by the number of cows with a record of having calved in September and October, and not having shown signs of æstrus during the whole of the winter; others had calved, had had one æstral period without service and had then gone into a dead anæstrus state; others again had been served, had shown no further signs of visible æstrus and were found to be barren on examination in November, December, January and February. He considered the solution of the problem of overcoming the state of dead anæstrus during the winter months was an urgent one. If 1,500 rat units of pregnant mare serum could be relied upon to have the desired effect then it should be made available for much more general use, and if one could overcome the state of dead anæstrus which one found during the winter months, particularly in heifers, it would materially help in augmenting the milk supply and shorten the periods between calvings in cows.

Mr. N. J. Scorgie said that in regard to the type of infertility in cows and heifers which was manifested by return to cestrus at the normal time despite repeated services, he had tried the method of enucleation of the corpus luteum recommended by Dr. Hammond, but that in his experience this treatment had not been very successful. Enucleation of the corpus luteum at ten to twelve days after cestrus had been practised on a total of 50 cows and heifers; most of the animals had shown cestrus within five days

and were served at this œstrus and at the succeeding one nineteen to twenty-one days later, but only in a small proportion of cases had pregnancy ensued. The animals in question belonged to three different dairy herds, which were tuberculin tested and free from brucellosis. There was no evidence of vaginitis or endometritis in any of the treated animals, and in one of the herds repeated bacteriological examination of swabs taken from the cervix had failed to reveal the presence of any organisms of significant importance.

Referring to sterility and low fertility in bulls, the speaker said that this was of considerable importance at the present time in view of the greatly appreciated value of well-bred dairy bulls. The underlying causes of low fertility in bulls was difficult to determine but American workers had found that under certain conditions cattle do not synthesize all the vitamin C they need for normal functions; one result of this was that the breeding efficiency of bulls is impaired. The workers referred to had reported that the subcutaneous injection of ascorbic acid in appropriate cases resulted in marked improvement in 60 to 75% of the bulls treated. Recently the speaker had had the opportunity of instituting this treatment in a number of selected cases but it was too early yet to assess the results. The type of case being treated was where bulls were failing to get cows in calf and where examination showed the semen to be of poor quality, particularly as judged by viability time of the sperm in storage at 5 to 10° C.: it was obvious that other possible causes of infertility both in the cows and bulls had first to be eliminated before seeking to attribute the infertility to a deficiency of ascorbic acid. For those who were interested, the speaker stated the treatment consists in the bi-weekly subcutaneous injection of 1 to 2 g. of ascorbic acid dissolved in sterile distilled water over a period of five to six weeks.

Mr. L. E. A. Rowson said he had been using stilbostrol throughout the winter on both ancestrous cows and heifers and the results had been very poor. Most of the animals had shown signs of cestrus with slight swelling of the vulva and discharge, but many had refused to take the bull and had subsided into the ancestrous state again with no heat

at the next expected period.

A specific group of heifers had all failed to respond to stilboestrol and after leaving them a few weeks 1,500 international units of pregnant mare serum had been injected. All but one of the animals had either come into cestrus or ovulated without showing symptoms of it. The one failure was in an animal in extremely poor condition and this may have played a part in preventing cestrus.

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# Section of Obstetrics and Gynæcology

President-J. M. Munro Kerr, LL.D., M.D., F.R.C.O.G.

[February 20, 1942]

## Observations on Living Eggs of Mammals

By W. J. Hamilton, D.Sc., M.D., F.R.S.E.

The methods employed for obtaining living mammalian eggs were discussed and the methods used were described. Some of the photographs were obtained by using a Vickers Projection Microscope which, having the optical system inverted, is particularly suitable. Other photographs were taken with a vertical camera adapted to the microscope. Incidental and transmitted lighting were employed.

Lantern slides were shown of photographs of living unsegmented and segmenting eggs of some ungulates, carnivores and rodents. The vitellus of the egg is surrounded by the zona pellucida which appears to be a homogeneous, transparent capsule (figs. 1, 2 and 4). In the living unfertilized egg the vitellus completely fills the cavity enclosed by the zona pellucida (fig. 1). After fertilization the vitellus undergoes a shrinkage so that a distinct perivitelline space is found (fig. 2). In this space the vitellus and the polar bodies are free to move. In fixed specimens the perivitelline space is obliterated by the contraction of the zona pellucida which becomes opaque (fig. 3).

The appearance of the living vitellus, with special reference to its fatty contents, in the different eggs was described. In the Golden Hamster (a rodent) the vitellus has a yellowish appearance and contains no fatty globules (fig. 2). The vitellus of the ferret (a carnivore) is almost completely filled with fatty globules so that it appears almost opaque. The other eggs shown were graded into intermediate positions between these two extremes. The appearances seen in the living eggs were contrasted with the appearances seen in fixed and stained specimens.

At fertilization the entire sperm, head, middle piece and tail, enters the ovum; the tail, however, is soon no longer visible in the vitellus. On account of the absence of fatty globules in the ovum of the hamster the entire sperm can easily be recognized in the living egg. In other mammalian eggs examined the presence of the head and tail of the sperm can only be recognized after the egg is sectioned and stained.

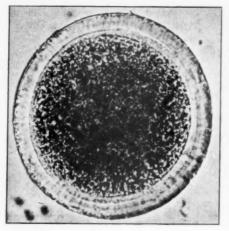
At the first division two blastomeres are produced which are usually of unequal size. The two blastomeres do not divide synchronously so that a three-cell stage is found; this stage, however, is soon followed by a four-cell stage. The spindles of division at the two-cell stage are arranged at right-angles to each other so that when the division is completed the resulting four cells are arranged in pairs which lie crosswise. The cells of the four-cell stage do not divide at the same time hence stages of 5, 6, 7 and 8 cells are found. At the 8-cell stage there is again asynchronous division until a morula is formed.

In most mammals the egg reaches the uterus at the morula stage and usually on the fourth day after ovulation. Soon after the egg enters the uterus it absorbs fluid and becomes a blastocyst (fig. 5).

A brief description was given of the attachment of the blastocyst of the hamster to the uterine mucosa. This animal is remarkable among eutherian mammals in having a gestation period of sixteen days.

The following cases were discussed:

- (1) Miss Alice Bloomfield, F.R.C.S., reported on a case of primary sarcoma of the ovary.
- (2) Mr. Albert Davis reported three fatal cases of septicamia due to Staphylococcus albus following induction of premature labour with a rubber tube.
- (3) Miss Margaret Basden, F.R.C.S., showed a specimen of a uterus removed on account of a rupture of an old Cæsarean scar.
- (4) Mr. R. Leslie Dodds, F.R.C.S., reported on a case of torsion of a pregnant uterus in which was a fibroid the size of a lemon.



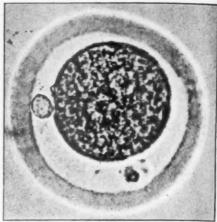


FIG. 1.

FIG. 2.



FIG. 3.

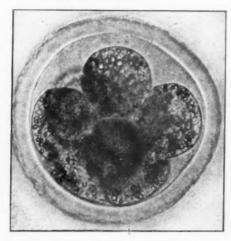




FIG. 4.

FIG. 5.

FIG. 1.—A photograph of the living unfertilized ovum of the cow. × 350.

FIG. 2.—A photograph of the living fertilized ovum of the Golden Hamster. A perivitelline space is present and in it the two polar bodies are seen. In the vitellus the pronuclei are just visible. × 460.

FIG. 3.—A photograph of a 2-cell stage of the ferret stained with osnic acid to show the distribution of the fatty material. × 420.

FIG. 4.—A photograph of the living ovum of the cow at the 10-cell stage. 6 cells are distinctly visible. The outlines of the others may just be discerned. × 350.

FIG. 5.

FIG. 5.

Photograph of the living unfertilized ovum of the cow at the 10-cell stage. 6 cells are distinctly visible. The outlines of the others may just be discerned. × 350.

FIG. 5.

FIG. 5.

### [May 15, 1942]

## DISCUSSION ON MATERNITY SERVICES

Dame Louise McIlroy (Abstract): In opening a discussion on maternity services the starting point must be the welfare of the patient and her wishes in the matter. A maternity service scheme must fit in with the general plan of a composite State medical or health service. With the establishment of the Royal College of Obstetricians and Gynæcologists, obstetrics now takes its place on an equal footing with medicine and surgery and is not merely a special branch. It has had close collaboration with the public health services. The introduction of antenatal care has given a much wider scope for the practice of preventive medicine, and teaching has expanded beyond the abnormalities of the bony pelvis and the positions of the fœtus.

The obstetrician now works in collaboration with the orthopædic surgeon, the pædiatrician, the cardiologist and the tuberculosis specialist. The help of the pathologist and the radiologist is frequently required for accurate diagnosis, and much more time is now expended upon the clinical examination of the patient than formerly.

Social services also play a large part in the practice of midwifery. Institutional expenditure in other directions could be reduced if we could reduce or eliminate the blindness due to ophthalmia of the newborn. Mental deficiency due to injuries at birth, could be reduced to some extent and the incidence of tuberculosis could also be lessened, if there were more provision for prolonged residence in sanatoria and facilities for childbirth in these institutions. With more efficient postnatal care the crippling effects of childbearing upon women would also be reduced. Antenatal care would lower the neonatal deathrate due to prematurity, birth injuries and malnutrition.

The economic aspect of maternity practice is of the utmost importance to the State. In my opinion, infant welfare should be under the direction of the pædiatricians after the first month of life. Gynæcology cannot be separated from obstetrics as treatment is required for postnatal complications.

Much of the organization of the maternity services has been haphazard and lacking in co-ordination. This, to some extent, has been inevitable. New ideas and methods had to be tried out by voluntary organizations and proved to be valuable, before public funds could be utilized for anything approaching an experiment.

could be utilized for anything approaching an experiment.

Legislative reforms, such as the various Midwives' Acts, have brought about great advances in midwifery. Local authorities were given permission to make use of public funds for maternity and child welfare work. It might have been better if, in some cases, these powers had been made compulsory. The Local Government Act of 1929 made a great advance in the establishment of maternity beds in Municipal and County hospitals. The London County Council is an outstanding example of this improvement. It is more satisfactory to have a maternity department in a large general hospital than in isolated units, with the exception of small maternity homes linked up with larger hospitals. In a general hospital auxiliary services are easily obtainable for consultative work, and there is economy of staff and equipment.

In building up a scheme it is well to find out what is essential, what is deficient in existing schemes, and what should be avoided. In some areas under a keen medical officer of health, the arrangements are excellent and the work with the local practitioners is harmonious. In others the standard of efficiency is low. Neonatal mortality on the whole has been very little reduced, and for this the obstetrician must bear the responsibility.

The chief defect in our present maternity services is the limited number of beds in industrial areas. Antenatal and postnatal beds especially are very inadequate. Emergency cases in rural areas may have to be sent long distances because no beds are available and general hospitals may have little provision for maternity cases.

able and general hospitals may have little provision for maternity cases.

In the future it is probable that domiciliary midwifery will be still further reduced owing to the difficulties of housing and home service. Flats are unsuitable and are noisy, and women should not have their confinements in slum dwellings.

Rest from household cares and good nursing have a marked beneficial effect upon the nerves of women. This is supplied by hospitals and local maternity homes. During the war, however, residents in evacuation areas often are forced to have their confinements in overcrowded homes, as the local maternity homes are booked up for patients coming from cities and towns in more dangerous areas. Patients are sent out of hospital too soon in some cases owing to pressure upon the beds for childbirth. Convalescent homes are also an important part of a scheme for maternity services, for antenatal as well as for postnatal cases.

Antenatal clinics in connexion with maternity hospital staffs are satisfactory, as there

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is continuity of supervision throughout pregnancy and childbirth. In country and municipal antenatal clinics, however, the assistant medical officer, whose special qualification is the possession of a Diploma in Public Health, may have had little clinical experience of midwifery. The chances of promotion in such a service, for women especially, are small owing to lack of special training in administrative methods. Local authorities, however, are beginning to recognize this difficulty and to insist upon a Diploma in Midwifery. If complications arise during pregnancy the patient is either sent to hospital or to a local practitioner who may not be very interested in her condition, as she preferred to attend the clinic at the outset of the pregnancy. In cases where a midwife is in attendance at the confinement, a local doctor is called in if any complication arises and, with no personal knowledge of the patient's previous condition, he may criticize the treatment at the clinic. If the patient is seen later at the postnatal clinic, criticism of the methods employed at childbirth may occur. Midwives who do not work with a recognized team of practitioners serving on a midwifery rota find it not always possible to get help in an emergency, and delay may be serious for the patient concerned.

The fault lies in this practice of dual responsibility and absence of continuity of supervision. This may be illustrated by the proverb: "Never swap horses while crossing a stream."

In some areas, especially when at a distance from towns, the local practitioners should be chosen as a team because of their competence to practise midwifery, and consultative clinics and services should be available. Facilities for hospital treatment should be readily obtainable. The patient should not be discharged from the supervision of the doctor and midwife until four weeks after the confinement. This would reduce to some extent the difficulties which are met with in breast feeding.

We owe a great debt of gratitude to voluntary organizations and hospitals in midwifery practice. I am glad that the Minister of Health intends to retain these institutions in a general scheme for medical services. Voluntary contributions will be difficult to obtain after the war, and financial assistance will have to be given by the State if the voluntary hospitals are to retain their individuality. This may mean a loss of administrative control and independence, but the hospitals will gain by being included in the general scheme and given a definite position therein.

This will do away with overlapping and waste of beds in some areas, and will supply accommodation in other areas where hospital resources are inadequate. It would also reduce the long waiting lists for admission and the overcrowded out-patient departments. The voluntary hospitals have done much for teaching by supplying clinical facilities for the medical schools. The healthy spirit of competition does much to make the individual wish to excel. Each special department of the large hospital is sponsored by an honorary head or "chief" who feels himself responsible for its efficiency, and by having a say in the appointment and control of his staff, expects whole-hearted co-operation and lovalty.

Consultants are now paid in hospitals such as those of the London County Council, some being whole- and others part-time. The question is, will the future generation of consultants be willing or able to serve as honorary members of the voluntary hospital staff? The answer is not far to seek. The traditions of the voluntary hospitals must not be lost as they are a bulwark against a completely socialistic scheme of State service. Coordination of the hospitals is being achieved to some extent by the establishment of the Emergency Medical Service hospitals and by the Nuffield Provincial Hospitals' Trust. These are on the lines of central councils and hospitals with regionalization of areas. The Council of the King Edward's Hospital Fund for London has done much to improve the buildings and equipment of the voluntary hospitals. Would a whole-time State Medical Service give the same incentive to original research as under the voluntary system? Would promotion depend upon clinical or administrative ability?

In general practice midwifery has declined to a great extent, owing to the efficiency of the midwives' services, the establishment of clinics and hospital beds, and also because of the unsuitability of patients' homes. The decline of the birth-rate is also a factor.

The National Health Insurance does not directly include the treatment of midwifery patients, nor does it give special consultant services and hospital accommodation. The panel doctor is too busy to take up midwifery practice with its inadequate remuneration, and he objects to the risk of criticism from local health authorities if cases should go wrong. Cottage hospitals have a limited number of local practitioners in attendance, and others may be excluded from the treatment of their patients when admitted. Small maternity homes should be established where the family doctor can admit and be responsible for the treatment of his own patients. Consultants and auxiliary services should be available from a larger supervising hospital centre.

In rural areas the family doctor would act in a part-time capacity as he would have

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to undertake other branches of medical practice. Women prefer local hospitals where they can be kept in touch with their families and relatives. The family doctor has been the trusted adviser and confidant of his patients as is the priest and lawyer. He is chosen because of the personal element. He knows the home conditions and circumstances as no whole-time practitioner or consultant can know them. In official centres case records are open to the inspection of a staff who are under no Hippocratic oath. Consultation clinics do much to relieve the anxieties of the general practitioner and discussions can take place as to diagnosis and treatment. The family doctor is, moreover, the first line of defence in the case of disease. But the doctor must have adequate training and must keep up to date by regular refresher courses in larger centres.

A team of doctors and midwives working in collaboration with a keen medical officer of health would ensure good results in these areas. Local clinics or centres could be established for interviewing and treating patients, but such centres would have to be instituted by the local health authority, as otherwise there would be difficulties of administration. Payment for work done would be given by the health authority and collected when possible from those patients who could afford to pay or who are specially insured. If any criticism arises it should be considered first by the committee of local practitioners and consultants before being judged by a lay board of management.

In Scotland domiciliary midwifery is more in the hands of the general practitioners than it is in England and Wales, and the midwives work directly under the doctor. The Scottish Board of Health Act (1937) was a scheme for this co-ordination of practitioners, midwives and consultants, and it has been established in a large number of areas. Lanarkshire, with its central maternity hospital at Bellshill, is a notable example of its efficiency. The patient has a choice of doctor from the local team of practitioners. The consultants on the staff of Bellshill hospital must hold the membership or fellowship of the Royal College of Obstetricians and Gynæcologists.

The Russian public health services seem to serve as a basis for many discussions on proposals for a State medical service in this country.

In Russia all medical education is free and all doctors are whole-time practitioners under the U.S.S.R. The whole aim of the service is the prevention of disease. Every citizen has a right to free medical treatment. Some of the expense is recovered by contributory schemes of health insurance. Women in employment get full pay for the eight weeks before and the eight weeks after confinement when off work.

The medical practitioners get study leave and retire on pensions. In the local areas are health centres or polyclinics and these are linked up with larger centres and hospitals. The teaching schools and research departments form the centre of the scheme. Local and central committees or soviets control administration.

A maternity service should give the patient a choice of doctor at the periphery and consulting and specialist services should work up towards the centre. There should be a central advisory committee composed of representatives from the universities, the Royal College of Obstetricians, the British Medical Association, Central Midwives' Board, College of Midwives, hospitals, and other organizations interested in the practice of midwifery. The administration of such a maternity service should be in the hands of those who have a considerable knowledge of the practical side of obstetrics as well as of public health.

Mr. Eardley Holland: The present state of maternity services may be fairly judged by considering the trend of maternal mortality. It is logical to take the maternal mortality rate as a yardstick by which to measure the quality of the service, and it may be assumed that the rate bears a fairly constant ratio to the amount of maternal injury and ill-health.

During the last five years the rate has shown a definite fall, both for the deaths from puerperal sepsis and for those from other causes. The deaths from sepsis have fallen about 60%, and the latter about 40%. Had this gratifying fall not occurred it would have been a grievous disappointment in view of the efforts that all concerned have made during the last twenty years. But the maternal mortality rate could be made to fall considerably more, and could probably be brought down to about half of what it is at present.

I think we are all agreed that obstetrics is far better taught, both to medical students and pupil-midwives, in large maternity hospitals or maternity units of general hospitals of university standard. This is not only because of the largeness and variety of the material but also because those institutions facilitate the training of young specialists. Even now there are not many teaching hospitals in London large enough to train young obstetric specialists.

The list of the respective number of maternity beds at hospitals in association with undergraduate medical schools shows Glasgow at the top, then come Edinburgh, Leeds, Liverpool, Manchester, Belfast, Newcastle and Sheffield; and then, in order of diminishing numbers, come the London medical school hospitals headed by University College. This position must be altered. Young specialists must be trained in large obstetric units, such

as exist at Glasgow and Edinburgh and at some of the English provincial university

What I have said with regard to medical students applies also to the teaching of pupilmidwives. This teaching suffers a great deal from the fact that much of it takes place,

alike for Part I and Part II, in petty maternity schools.

Since September 1939 I have been at work in a certain county as obstetric consultant and one of my duties is to investigate every maternal death. This county has a very low maternal death-rate—in 1939 only 1.8 per 1,000. One of the generalizations that can be made from a study of the 60 consecutive deaths which I have investigated is that 40%

of them occurred from shock and collapse.

From this it follows that institutional midwifery, so long as the institution is in the first class, is safer than domiciliary, for the simple reason that facilities for blood and plasma transfusion are always at hand. Another point about maternal mortality is that many of the deaths are wrongly certified. Another is that the confidential reports on maternal deaths that are made to the Ministry of Health are extremely valuable and a mine of information, provided they are closely scrutinized and supplemented by personal interviews and by examination of records by an expert obstetrician. Another generalization is that far more deaths occur from lack of judgment or skill during labour than from imperfect antenatal care.

In the emergency maternity service of this county (run on behalf of the Ministry of Health for evacuee expectant mothers) there are a number of maternity homes and two maternity hospitals (converted mansions). All have a staff of first-class midwives, and each home has a general practitioner (selected as carefully as possible) to take medical aid calls. The maternity hospitals, each with R.M.O., and at one of which I myself live, support the whole system; abnormal cases are taken into them, and emergencies come in

by ambulances.

The results have been successful. In the two years 1940-41 there were 5,500 births in these homes and hospitals, and six mothers died, either in the homes and hospitals or in other institutions to which they had been transferred. After deducting one "associated death" (a case of severe puerperal insanity, with death from septic parotitis and myocardial failure, in a mental hospital) five direct puerperal deaths remain, giving a mortality rate of 0.9 per 1,000. Among the 5,500 births there were 390 cases of hypertensive toxæmia of pregnancy (including 8 eclampsias), 60 Cæsarean sections, 206 postpartum hæmorrhages, 27 placenta prævias, 367 forceps deliveries, 50 manual removals of placenta and so on-a good mixture of abnormal cases. A mortality of 0.9 per 1,000 with clinical material like that in improvised institutions is surely a demonstration of the safety of institutional midwifery. The credit goes primarily to the midwives, and then to the general practitioners who responded to the medical aid calls, and third, perhaps, come the specialized services and leadership at the central hospital.

I have some figures for the London County Council, kindly sent to me by Dr. Allen aley, which are equally remarkable. The total number of confinements in 1938 in Daley, which are equally remarkable. London was 66,000, of which 45,000 were institutional, and no fewer than 21,000 of these were in L.C.C. hospitals. The mortality for the booked cases was only 0.9 per 1,000.

In planning for the future, it may be said that there is already in existence a national maternity service, namely, that administered by local authorities. But admittedly it has inherent defects. It is in the hands of 62 county councils, 83 borough councils, and 283 district councils, all of them separate and independent maternity and child welfare authorities, each carrying its own maternity hospitals and homes, its own antenatal clinics, and its own salaried services of midwives. Whitehall has to deal with all these independent obstetric units. On the whole this form of service has worked well. But the system lacks form and unity. The administrative units are far too numerous, and, with few exceptions, far too small. There is no co-operation, so far as I know, between the independent units; and even within the individual units there is usually imperfect co-operation between the various elements-e.g. the voluntary hospitals, the local authority hospitals, the medical officers of the local authority, the general practitioners (this criticism does not apply equally in all units)-and the standard of the work done in some of the small maternity institutions is low.

It is difficult to see how there can be any leadership or inspiration in the present maternity service; there is no provision for such, either at the centre or the periphery. The standards of work attained by the different local authorities naturally show great differences. The most lamentable thing that has happened since the last war has been the separation that has come about between the Officials in Whitehall and the practising

Obstetricians and teachers.

I am in favour of a National Maternity Board or Council responsible to the Minister, with the local authorities as its agents (just as the local authorities are now the agents of the Ministry for the Emergency Medical Services). Upon this Board all interests would be represented. Nearly all are agreed on the advantages of regionalization, with units of sufficient size to allow the full development of obstetric services. The central component would be the regional obstetric centre, with the central hospital. Central hospitals would be of university standard, with, at the lowest, 100 obstetric beds and a suitable number of gynæcological beds. If they could be associated with, though architecturally separate from, a general hospital, so much the better. At the head of each there should be an Obstetric specialist of high standing, with his assistants. Some would be teaching schools for specialists, practitioners, students or midwives.

Such an obstetric standard would provide leadership and inspiration, by example and precept, to the peripheral components, by which I mean the general practitioners, the midwives, and the smaller hospitals and maternity homes. Over these the central hospital chief would exercise a general benevolent clinical supervision, both as regards institutional and domiciliary work. The central hospital would be a great inspiration to the obstetrically-minded general practitioner. The creation of an Obstetric Centre such as that in each region would be, I think, the most important factor in the whole of the future

obstetric service of the country.

Finally, I think that midwives should be given more responsibility and better status. The service could not possibly be run without the obstetrically trained and interested general practitioners. Some practitioners are becoming more and more interested in obstetrics, and others less and less. That is a movement in the right direction; for it will lead to a process of selection amongst them as regards midwifery practice.

Sir Alexander MacGregor (Medical Officer of Health, Glasgow) agreed with Mr. Eardley Holland that the rules of the Central Midwives' Board might be relaxed so as to give the trained midwife more latitude in her duties. In Scotland the law had gone a good deal further than in England, and had set up a domiciliary medical service which was now operated by a large number of local authorities. The Glasgow scheme had not yet come into being owing to the war, but it was being clearly shown that the tendency was all towards greatly increased accommodation for lying-in patients in institutions. This movement, which had been growing for many years, had been much accelerated since the war began; it was one which women themselves desired, and which was eminently advantageous both on public health and social grounds. For these reasons, therefore, he thought that a maternity service should include all the facilities available to women and not lay the emphasis on the purely domestic side of midwifery, as the Maternity Services Act had done. Provision of additional indoor accommodation, both for antenatal treatment and for lying-in, should be one of the first aims of post-war hospital policy.

The proportion of confinements which took place in institutions in Glasgow was 45%—much lower than the 60% figure for London. Another feature was the popularity of the antenatal centre, to which more and more women were coming each year. His view was that the maternity hospital (preferably the maternity unit of the general hospital) with its antenatal centre, along with its associated antenatal and postnatal clinics in the area of the city round about it, should be the pivot of a maternity scheme, and that the antenatal clinics and the work in the hospital should be carried out by a group of trained obstetricians, who should be available on call to the midwife of the district. It was intended to base the Glasgow scheme on this principle. Only 47 out of over 600 medical practitioners notified over 20 births per annum in 1938 as having occurred in their

private practice.

If there was to be any future legislation in the sense of introducing a complete, well-knit, and harmonized maternity service, great latitude should be allowed to different areas. What Mr. Eardley Holland had pictured as an ideal scheme for a county area—which he did not oppose for a moment—might not serve for large industrial cities. Of course, this proposal for a whole-time service had given rise to a great deal of powerful opposition, and had not yet been formally approved. But he did not wish to introduce a service which would perpetuate confinements in small houses, the service should be based to an increasing degree on the maternity hospital and the antenatal clinic functioning together.

Mr. Arnold Walker said that there was one fundamental difference between a maternity hospital and other hospitals; in general, the maternity institution cared for the healthy while other hospitals were concerned only with the treatment and care of the sick. The maternity institution, of course, dealt with many cases that were pathological, and its chief value to the community rested in its ability to treat the pathological efficiently and expeditiously, but that did not affect the argument that a maternity institution had as its primary object the safe conduct of a mother and her baby through a natural but hazardous period of their lives.

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This point of view was tending to be lost, chiefly because of the great increase in the maternity departments of general hospitals. Unless the authorities regarded the maternity department as something different from the rest of the hospital, and made it as independent as circumstances allowed, childbirth tended to become just another disease. This unfortunate attitude had a very real effect upon the pupil-midwives who were trained in these maternity departments, and, from such information as was at present available, it appeared that a much lower percentage of pupil-midwives trained in schools attached to general hospitals eventually practised midwifery than was the case with pupils trained in special maternity hospitals.

The principle of the maternity department attached to the big hospital was likely to be extended at the expense of the special maternity hospital. The idea appealed to the tidy mind of the administrator, and a great deal too much stress was laid on the value of

the ancillary services which were available.

Turning to the question of the medical staffs of maternity institutions, in general, voluntary institutions were controlled by a number of obstetricians who exercised their control as a committee, while municipal institutions were controlled by one individual. The qualifications of this individual were varied. He might be the medical superintendent of a large general hospital, who might or might not be interested in midwifery; he might be the medical officer of health, who probably knew nothing about practical midwifery; he might be a whole-time assistant medical officer with some experience of midwifery, and,

lastly, he might be a practising obstetrician.

Almost all municipal institutions now made use of the best obstetric skill available. Some, like Middlesex County Council, employed whole-time obstetricians, and others employed obstetricians as consultants who were called in when the resident medical officer considered it necessary. In these cases the consultant was concerned only with the particular problem put before him. When the medical officer had had a reasonable amount of experience this system worked fairly well, but it was more than likely that the consultant would be interested only in the particular problem with which he had to cope rather than

with the efficient running of the department as a whole.

Control by the obstetrician seemed to be the ideal method, provided conditions were such that he was able to keep in close touch with all that was going on. The link between preventive and clinical medicine was perhaps closer in midwifery than in any other branch, and the role of the obstetrician should primarily be to prevent complications, and secondarily to treat such as he was unable to prevent. These principles had been in operation at the Willesden Maternity Hospital during the past eleven years during which the speaker had been consulting obstetrician. While all administrative matters were dealt with by the M.O.H., complete clinical control was left to the obstetrician. In 9,000 cases, the booked mortality rate was under 1:1,000.

In planning the maternity institutions of the future, the most important single factor was unification of control. There was nothing new in this idea, and it had for long been

the practice in Dublin.

There was one point he wished to mention concerning the position of midwives in maternity institutions. Obstetricians were, he thought, in general agreement that the foundation upon which the maternity service now and in the future must be built was a well-trained body of midwives supported by an adequate but limited number of equally well-trained medical practitioners. In domiciliary practice no one questioned the fitness of the midwife to care for the normal case, and everyone rightly trusted her to call in medical aid when an abnormality arose. In the great majority of maternity institutions this principle was accepted, but certain incidents had cropped up recently which showed that in some places experienced midwives were treated as nothing but maternity nurses. The effect of this mental attitude on the part of the medical officers had been disastrous to the morale of the department. Good midwives would not put up with it, and pupils left the school with a false idea of the place of the midwife in the maternity service. For over eleven years he had considered the midwives to be in charge of all normal cases at Willesden and had made them responsible for calling his house surgeon or himself.

Dr. W. Allen Daley (Medical Officer of Health, London County Council) said there were five elements to be considered. The first was the patient. In this democratic country the patient would have the last word, and it was finally the patient, expressing her opinion through the local authorities, who would say whether or not this service was to be primarily a domiciliary or a hospital service. So far as L.C.C. hospitals were concerned the expression of the views of the patient was significant: in 1930 there were 10,000 confinements in L.C.C. hospitals, and in 1938, 21,000. There would probably, however, always be some demand for domiciliary confinements.

The second element was the midwife. She must have adequate training and refresher

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The third element was the doctor, who must also have adequate training. It was now much better than it had been, but owing to shortage of beds in the London teaching hospitals the resources of the L.C.C. maternity units were used largely.

The view has been taken that the qualification to be demanded of general practitioners called in by midwives under the rules of the Board should not be simply willingness to attend but that this must be linked with some evidence of competence.

The fourth element was the system itself. The service should function as a whole. The domiciliary service should be linked more closely with the hospital service, and the antenatal service should be a constituent of both. There should be maternity departments in general hospitals rather than ad hoc maternity hospitals. Mention had been made of the relative values of part-time and whole-time service in institutional midwifery. The L.C.C. in its maternity units had adopted the system which had just been outlined by Mr. Walker. Experienced part-time obstetricians were in charge, and this had been of great value to the service, but circumstances differed and in some areas a whole-time officer might be preferable. He agreed that the obstetrician should live in or near his hospital.

Reference had been made to one-man administration as against administration by committees. In the L.C.C. service very great benefit had been derived from conferences with all their obstetrical experts to consider each maternal death and questions of general principle.

The last element was administration. He thought this should be in the hands of the major local authorities, as they were the hospital authorities. Schemes were afoot for cementing the partnership between municipal and efficient voluntary agencies, and that was the line on which development would most usefully take place.

Cold water had been thrown upon political control. Having been employed by politically elected municipalities for over thirty years he felt that democratic control in this particular service was a great driving force. He had never had the slightest difficulty in getting any advances in maternity work approved by his committees and he knew that in some areas it was the politically elected councils which had themselves pressed for developments. In this service there was no difficulty in obtaining authority to expend public money.

Dr. Dick Read said that those who worked in the homes had a different point of view from the teachers in hospitals. Obstetrics was the greatest and most far-reaching branch of our science. It had never been below the level of medicine and surgery; production plants were usually more important than repair shops.

Dr. Walker's vision of the individuality of maternity services apart from general hospitals was undoubtedly correct. Mr. Holland had remarked that "the habitual vision of greatness was very unlikely to be seen in obstetrics". Academic obstetrics, perhaps, but the habitual vision of greatness of all healthy-minded women was childbirth. The birth-rate was falling; our profession was not blameless; the public had not been taught; the trend of culture and civilization had been allowed to inhibit the laws of nature. It was largely our business to rectify this absurdity. The reconstruction of communal life demanded a new philosophy. It would not be found in maintenance or repair; it would be found in those spiritual and physical forces which prompt reproduction of the species.

The birth-rate was a national problem of fundamental importance, and a special Ministry of Reproduction, including experienced obstetricians of administrative ability, should be demanded of the Government.

There was good reason to believe that politicians would welcome and assist such a design. The greatest opportunity that any group of scientists in the world had ever been given for the introduction of new standards, economic, domestic and philosophical, was in the hands of the obstetricians of this country to-day if they had the foresight, the unselfishness and the courage to emerge from the carapace of conservative principles.

Dr. Winn Everett said that she wanted to emphasize the necessity of retaining the general practitioner in any scheme for improving the maternity services of the country.

This necessity was apparent for two reasons. The first was the personal relationship between doctor and patient. The second was that the number of doctors required to staff an efficient maternity service would render the exclusion of the general practitioner a practical impossibility.

In the scheme for an improved maternity service, which she wished to outline, a list would be drawn up in each area of doctors wishing to practise obstetrics and willing to attend post-graduate courses in the subject.

There would be central consultants—obstetrical specialists—wholly responsible for the organization of the service in the area under their control. Under these central consultants, there should be local consultants. They should have had at least ten years'

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post-graduate experience of obstetrical practice, with some experience of general practice and they should hold a higher degree in obstetrics.

As regards antenatal care and hospitals—maternity cases fell into two groups: (1) private cases, whose own doctor would be responsible for antenatal care; and (2) midwives' cases, who should attend antenatal clinics which should be run by the local consultants. All abnormal cases should be seen by their own doctor in consultation with the local consultant.

Adequate local hospital accommodation should be provided, the adequacy obtaining alike in regard to the number of beds, including private wards, and the equipment. The central consultant should be sufficiently mobile to work at these local hospitals.

The President, in summing up, said that what had transpired chiefly from this discussion was that institutional midwifery was increasing. In the L.C.C. area, before the war, over 60% of cases were attended in institutions. These people went voluntarily, and the institutions, when well run, showed extremely good results, as Mr. Eardley Holland had stated. The maternal mortality rate in some institutions was approaching the irreducible minimum. That meant that domiciliary midwifery must become less and less until, in industrial centres, it would entirely disappear. It would never entirely disappear in sparsely populated rural areas.

Here he would stress a most important point—this development might affect the medical curriculum. It might well be asked: Why give extensive training to a large body of undergraduates who were not going to practise obstetrics? A similar contention might be raised in respect to su:gery.

As regards midwives, if there were to be a very limited domiciliary service in the industrial areas there would be very few midwives practising in those areas—they would be transferred to maternity hospitals. Here he wished to support Dr, Walker in his confidence in allowing the trained midwife to supervise normal cases in institutions. It was most important that such responsibility should be delegated to her.

Further, there should be one head—not several heads—in a maternity hospital. That had been the principle in the Rotunda Hospital, Dublin, for wellnigh two hundred years. Until "Masterships" were established in maternity hospitals the ideal staffing of these hospitals would not be reached and, lastly, it was most important that the "Master" should reside in or close by the hospital.

He wished to remind Dame Louise Mcllroy that schemes practically identical with the one she had outlined were drawn up more than ten years ago—one by the late Professor Blair Bell and the other by himself. The outline of both schemes would be found in the Lancet for 1931 (ii), 367. In his own view the central directing body must be an ad hoc body, which he had termed the "Central Obstetric Board"—advisory committees were of no use, for the advice was generally put into a pigeon-hole and forgotten. He thought a sympathetic consideration would be given by the Ministry in Whitehall and at the Department of Health for Scotland if a sound scheme were brought forward for a "Central Obstetric Board" for each country. If such a body were established peripheral differences would be more easily settled—the Regions would have representatives of all agencies concerned in maternity and infant welfare. The service must be established at the centre, and from the centre the organization must spread outwards.

## [March 20, 1942]

## CLINICAL MEETING AT THE BRITISH POST-GRADUATE MEDICAL SCHOOL

Cases were shown by Dr. Meave Kenny, Dr. K. M. Harding and Professor James Young. Mr. Green-Armytage showed slides and photographs indicating the pitfalls in salpingography.

Pathological specimens were shown by Dr. A. I. Ross, and Dr. D. Daley and Professor James Young. Dr. Meave Kenny gave a demonstration of the precision stereoscope.

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# Section of Physical Medicine

President-Major G. D. Kersley, R.A.M.C.

[May 16, 1942]

JOINT MEETING WITH THE MEDICAL SOCIETY FOR THE STUDY OF VENEREAL DISEASES AT THE ROYAL VICTORIA HOSPITAL

# DISCUSSION ON GONOCOCCAL ARTHRITIS AND "RHEUMATISM"

Major G. D. Kersley: Rheumatism associated with gonococcal infection has three striking characteristics, the variety of the manifestations, the difference in duration between time of infection and onset of symptoms and its reaction to hyperpyrexia.

What are the criteria for considering a case of rheumatism as gonococcal? Is the man who has rheumatic attacks for years and who gets an acute flare up ten days after a G.C. urethritis to be classed as G.C. "rheumatism"? Similarly what of the man who has had a past gonococcal infection with or without arthritis who gets an acute flare up of rheumatism coincident with return of a urethral discharge which does not appear to be specific in origin? What of the spondylitic who has, years ago, had gonorrhæa (or may have had) and who has only a few pus cells on prostatic massage with no evidence of gonococci?

In a consecutive series of 50 cases treated as gonorrhoal rheumatism four fall into the group which had rheumatic symptoms previous to any known infection but were definitely flared up by a G.C. infection. It seemed likely from the similarity of their symptoms to those they had previously experienced that the infection had reacted in the same way as any other non-specific infection, causing a flare up in a sensitive individual.

In this series there were also four cases where the onset of rheumatism coincided with a recurrence of discharge, in which gonococci were not found, at times ranging from two months to twenty-one years after gonorrhoa.

One of these cases had gonorrhoa in 1924 but no rheumatic symptoms. The man remained fit until 1930 when, coincident with the recurrence of discharge, he developed a poly-articular synovitis which cleared up in four or five months. In 1941 the same sequence of events occurred. No gonococci were found in the discharge which only lasted a few days. The sedimentation rate was raised to 95 mm. with a white cell count of 11,000. The rheumatic symptoms cleared up in about two months. Was this due to a non-specific infection in the prostate, which was laid open to such an infection by the original damage by the gonococcus, or were gonococci still lurking in his prostate?

Excluding any cases of doubtful actiology for the moment, the clinical syndrome, if one can call it such, is still very varied. The brunt of the attack commonly falls on the fascia, tendon sheaths and ligaments, the plantar fascia and sheath of the tendo achillis being particularly frequently involved and particularly difficult to treat. Synovitis sometimes progressing to arthritis, especially of the larger joints such as one or both knees, is common. The amount of effusion may be great, wasting is marked but the intensity of the pain varies from slight discomfort on movement to intense pain allowing no rest. The reason for this is not clear. It does not vary with the acuteness of onset of the swelling. The painful type is at times liable to be confused with acute gout.

Monarticular and polyarticular forms occur according to Hench in the ratio of 2:3. From review of the literature he was of the opinion that it was between 1% and 3% of cases of gonorrhoa that develop arthritis. In Lieut-Col. King's series of 2,689 cases of urethritis it occurred in 2.4%. Weisenbach considered that of 1,445 cases of chronic arthritis 8:8% had a gonococcal infection as their basis.

Certain other conditions occur in association with G.C. rheumatism so commonly as to be suggestive in diagnosis. Freyberg found that conjunctivitis and iritis headed the list with 20%, that keratodermia blenorrhagica occurred in 3% and that calcaneal periositis was also common. In our series there were three cases of keratodermia blenorrhagica, i.e. 6%, and two of marked calcaneal periositiis.

The sedimentation rate is said to be raised, as is the white count. The results of the complement-fixation test, which should be so useful, must be critically examined. As carried out at many centres it is valueless, and even when a satisfactory antigen is available

it is not a 100% diagnostic answer. Hench in a review found it positive in 80% of proven cases and 60% of probables. It has been found to be positive twenty years after an infection and is not a criterion of activity. A positive complement-fixation test may often be obtained from the synovial fluid, but it is certainly a no more delicate test in the synovial fluid than in the blood; moreover there may be a negative reaction even when gonococci can be isolated.

In our series of cases the average age was 25 but this was obviously influenced by the fact

that the group under examination were on military service.

In considering the length of time between the first evidence of infection and first rheumatic symptoms, out of a group of 37 cases, in 3 the symptoms were simultaneous. In 27 the average lapse of time was a little under two weeks while in the remaining 10, the average time was four years. In this latter group were included 3 cases with lapse of three months between the arthritis and the "rheumatism".

The frequency with which various parts of the body were affected was in the following proportions: Knees in 30 cases; ankles 14; fascia (mainly plantar or in the region of the tendo achillis) 10; wrists 8; back 6; feet 6; hands 4; elbows 4; acromio-clavicular,

shoulder and neck joints in 2 each; temporo-mandibular joint once.

The sedimentation rate was below 10 mm. in 5 cases, between 10-25 mm. in 4, 25-50 mm. in 10 and above 50 mm. in 6. The white cell count varied from 7,000-17,000, average 10,000.

In 37 cases the average hospitalization was 3.8 months and of these cases 27 were discharged to duty cured and 10 although improved had to be invalided out of the Army.

\*Treatment.\*—Apart from local treatment by heat, counter-irritants, massage, rest, &c.,

the therapeutic field may be subdivided into chemotherapy and hyperpyrexia.

Various preparations of the sulphanilamide group have been used by various techniques with some success. Hench estimates the cures at 60% and the treatment though unpleasant is easy and safe. There has been one death recorded in a series of 5,000 cases. The aim is usually to produce a concentration of sulphanilamide in the blood of 6—10% for ten to fourteen days and a similar concentration also occurs in the synovial fluid. Certain cases cannot take the drug or are sulphanilamide fast and some have actually flared up during its administration. Our treatment of rheumatic cases by this means has been somewhat disappointing and does not agree with the brilliant figures of Bauer and Short.

Fever therapy has been used by injecting T.A.B. (10 or more million) intravenously or by the more difficult but far more satisfactory method of hyperthermy. Here the thermolabile characteristic of the gonococcus is utilized, the body being raised to a temperature of 106-107° F. and maintained at that temperature for six to ten hours and two to four sessions are usually required. By this means Hench estimated that 90% of acute cases and 60-80% of chronic cases of G.C. arthritis are cured. The treatment necessitates, however, expensive apparatus and extreme care and skill if calamities are not to ensue. With care and experience, however, the dangers are not unduly great and are well justified by the results, there being only one death at the Mayo Clinic in giving 2,600 treatments to 620 cases.

The combined treatment of sulphanilamide and hyperthermy is still under trial but

the results are very promising.

The assessment of the value of various treatments by Culp gave pride of place to sulphanilamide and intravenous mercurochrome rather than to hyperthermy. Trautman found either sulphanilamide or hyperthermy gave results markedly superior to that obtained by local treatment alone. Hench records 10 cases yielding to combined sulphanilamide and hyperthermy treatment but resistant to both when applied separately. With regard to the benefit from other treatment, the table below shows the number of cases treated by various kinds of physiotherapy. Where possible not more than one type of treatment was started at a time and sufficient time was given to assess its apparent benefit to the patient before anything else was tried. Only where improvement was striking after a particular treatment was a note made to this effect.

Treatment	Number treated	Number markedly improved by treat- ment	% improved
Pelvic short wave	12	9	75
Local short wave	13	3 7	23 46
Heat and massage	11	<u>-</u>	
Prostatic massage	3	-	_
Faradism		Marrie Control	garage.

Pelvic short-wave was carried out by means of antero-posterior application of glass electrodes.

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Ionization was applied using saline. Where the joint was very painful and swollen the anode was used as the active electrode in order to obtain its analysis effect on nerve Where the condition endings and to employ any osmotic dispersal effect on the effusion. was more chronic and there was periarticular thickening, the cathode was used as a

Involvement of the plantar fascia was the lesion by far the most resistant to treatment

and seemed to benefit little from any form of physiotherapy.

So far 17 G.C. rheumatic cases have been observed under treatment by hyperthermy. the average number of treatments being between three and four per individual. All have received relief from their pain at least for some days after even their first treatment, spasm and swelling have usually decreased or disappeared and a number have volunteered that they felt better, their sedimentation rates have dropped and they have started to put on weight.

Only the plantar fasciitis cases have proved entirely resistant. It is too early to estimate exactly how many men this treatment will save from discharge from the Army. So far only the worst cases have undergone hyperthermy treatment yet only two have proved resistant, 12% instead of our previous figure of 27%. There has, however, been one death

Summary.—After analysis of the case histories of 50 cases of gonorrhœal "rheumatism" there appear to be two groups, those complaining of rheumatic symptoms shortly after development of a specific urethritis, usually within two weeks and at all events within three months (81%), and those where a flare up of a long-standing infection originally gonococcal seemed to be responsible.

2.4% of cases of urethritis developed arthritis.

Certain clinical features have been analysed; the knees and ankles were chiefly affected and the fascial structures were next in frequency, the latter being especially resistant to treatment.

The length of hospitalization required, 3.8 months, and the large percentage of resistant cases, 27%, is stressed.

Treatment is discussed and where hyperthermy is not available pelvic short wave coupled with local galvanism appears to give the best results. The importance of hyperthermy is borne out by our figures.

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Lieut.-Col. Ambrose King: In dealing with the metastatic lesions of gonorrhoa the venereologist is primarily concerned with the investigation and elimination of causative foci of infection. For this purpose no distinction need be made between joint and connective tissue infections since they are due to similar causes and run a similar course. The number of cases under consideration in this series is 61 and includes all such cases treated during a period in which the total admissions of patients for the treatment of urethritis were 2,719, made up of 1,784 in whom the gonococcus was found, and 935 in whom the diagnosis was non-specific urethritis. The incidence of metastatic lesions in this group was therefore just over 2%. These cases may be divided into three main groups according to the time relationship between causative genital infection and meta static lesions.

The groups are as follows:

(a) 34 patients developed metastatic lesions in the course of the primary urethral infection either before treatment was instituted or during treatment.

(b) 4 patients who had had a previous attack of arthritis developed a fresh attack or

recrudescence of urethritis associated with a recurrence of arthritis.

(c) 22 patients had metastatic lesions of a subacute or chronic type associated with chronic prostatitis and occurring without obvious determining cause months or years after the original attack of urethritis.

#### DIAGNOSIS

The association between metastatic lesions and genital infection may be obvious or may require careful search and the application of specialized pathological tests. The principal diagnostic criteria are:

(1) Urethral discharge.—This is the immediate and obvious diagnostic sign which

suggests the relationship. It may present itself in three ways: (a) There may be a purulent discharge in which the gonococcus is found. This was so in 21 cases in this series.

(b) There may be a purulent discharge in which careful search fails to show the gonococcus. This by no means rules out the diagnosis of gonorrhœa and may on the other hand be evidence of poor tissue reaction against the gonococcus. 22 cases in this series were of this type. In such cases repeated smears and cultures may finally show the gonococcus if delay in treatment is considered justifiable. Even though repeated tests may be negative, they do not rule out the diagnosis of gonorrhoea. The gonococcus sometimes appears suddenly in the secretions later, even while the patient is under treatment, or may be found in the genital tract of an infected partner. The organism may also be found at a later date in cultures from the prostatic secretion.

It will be noted that the proportion of metastatic lesions occurring in patients with so-called non-gonococcal discharges (22 in 915, 2.4%) was twice as great as those occurring in those patients in whom the gonococcus was found (21 in 1,783, 1.2%).

(c) In other cases, 18 in this series, there is no detectable discharge or other manifest sign of urethral infection on examination during the day. It is essential in all such cases that the patient should be examined and a smear taken in the early morning before the urine is passed, and that this first morning specimen of urine should be inspected. Latent undisclosed infection may occur and the symptoms may be so slight as to escape the patient's notice. A further possibility is that the patient may have taken drugs of the sulphonamide group without disclosing the fact.

I suggest that conditions such as arthritis and fibrositis, which occur in association with genital infections without isolation of the gonococcus but which are clinically indistinguishable from similar conditions occurring in the course of gonorrhoa, are, in fact, truly gonococcal in origin, but that the available pathological methods fail to demonstrate

(2) Urine.—The urine commonly shows naked-eye changes which are indicative of infection. In acute and subacute infections the urine is turbid or hazy or contains heavy pus threads. On microscopy after centrifuge the smears show masses of leucocytes, In certain chronic cases, and others in which sulphonamides have been administered, the urine may show no evidence of infection. In such cases it is essential to examine the first morning specimen of urine which usually shows some sign if the urethra or its communicating glands are infected. The all-night urine test is of particular importance in the type of case with latent infection in which there is no detectable urethral dis-

(3) Rectal examination.—This may or may not give evidence of recent or oldstanding prostatic or vesicular infection such as localized or generalized changes in the consistency of the prostatic tissue or detectable swelling tenderness or thickening of the walls of one or both seminal vesicles. To find such changes is the exception rather than the rule. Occasionally Cowper's glands are a source of infection, and if they are palpable

in these cases they may be presumed to be infected.

(4) Prostatic smears.—The presence of more than an occasional leucocyte in the prostatic secretion must be considered abnormal and indicates chronic prostatitis. I believe that such an excess once present is likely to persist throughout life, whatever treatment is applied. In such cases the prostate usually feels quite normal to the exam-The association of chronic prostatitis and metastatic lesions, with or ining finger. without the history of past urethral infection, is a very common one. The early morn-

ing urine usually gives some additional evidence of genital infection.

(5) Prostatic cultures.—The successful cultivation of the gonococcus from the prostatic secretion is vital to the proper study and accurate diagnosis of metastatic gonorrhoa. The two necessities for this test are a suitably reinforced medium and a differential stain for the detection of the colonies of gonococci. Unfortunately the technique is difficult and highly specialized. Under present conditions this test has not been available to us. Dr. Orpwood Price, with whom I first had the opportunity of using this test, was kind enough to give me a note of his present views on this technique, and because I believe the matter to be of paramount importance I have summarized these views which closely agree with my own on the clinical points involved, and are as follows:

The difficulty lies in the preparation of a suitable medium which should consist of an agar broth base enriched by the addition of a natural albuminous fluid containing a high percentage of proteoses-such as whole blood, hydrocele fluid or egg white. War-time difficulties emphasize the importance of attention to detail. The lean meat from which the broth is made is often not fresh but has been frozen and perhaps re-frozen many times. In consequence there is a likelihood of the formation of amino-acids which do not favour growth of the gonococcus. Comparative failure over a period of time was traced to impure agar powder, and difficulty was also experienced in replacing the GerT 8

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man brand of peptone which before the war was superior to other brands on the market. The finished medium should have a pH of 7.3 to 7.5 and should be warmed to 37° before inoculation. All precautions must be taken to exclude contamination and the medium should be exposed to air for the minimum time. A specimen of prostatovesicular fluid, the largest possible quantity, should be expressed on to the surface of medium contained in a Petri dish and incubated for three to five days. One negative result is by no means conclusive and the test should be repeated on several occasions if necessary. A positive result is obtained when colonies of organisms give a positive oxidase reaction and on smear preparation show an abundance of typical gram-negative diplococci. Unfortunately, it is seldom possible to obtain these organisms in pure culture, and the sugar fermentation reactions cannot be applied. Taken in conjunction with the history and clinical signs, and the general morphology of the organisms there can be little doubt in such cases that they are gonococci.

The oxidase reaction is obtained by the application of one of two dyes to the surface

of the medium:

1% dimethyl-phenylene-diamine hydrochloride, or its equivalent tetramethyl solution. Price always uses the dimethyl preparation for it affects fewer groups of organisms than does the tetramethyl dye. Colonies of gonococci and certain others are stained purple

black by the reagent when properly prepared and kept.

A practical point about the use of these reagents is that they should be freshly made up in distilled water before use and that the powder should be kept in brown-coloured phials or bottles, since oxidation readily occurs on exposure to light and air. Even when partially oxidized the reagents fail to act satisfactorily and the gonococcal colonies may be missed owing to pseudo-reactions giving an extensive brownish-purple or black coloration.

The test is entirely dependent upon careful and accurate technique, and any relaxation of the standard results in failure to grow gonococci when they are present. Cultures made in this way frequently clinch the diagnosis of gonorrhoea when all other tests have

failed to show the presence of the causative organism.

(6) The complement-fixation test for gonorrhaa.—This is a valuable though much maligned test; few in this country have mastered the technique. The difficulty appears to be in the preparation of a reliable antigen. The test should be positive in about 90% of cases of acute gonococcal arthritis, but the percentage is much smaller in more chronic cases and in connective tissue infections. A positive test obtained with a reliable technique is strong evidence of gonococcal infection. The test as used in this group of cases did not give helpful results.

#### TREATMENT

The following methods of treatment have been used to eliminate causative foci of infection:

Urethral irrigations.-Apart from routine general measures this is the oldest form of treatment. Unquestionably it remains a useful treatment and posterior urethral irrigations by means of weak, warm (105° F.) potassium permanganate solution may give prompt success in cases of metastatic gonorrhoa which have failed to react to other methods. A skilful careful technique is essential for the success of this treatment. Errors in technique are likely to lead to trauma of the posterior urethra and extension of the metastatic infection.

Prostatic massage.—This procedure is commonly practised in the treatment of subacute and chronic metastatic infections. In such cases there is almost always evidence of chronic infection of the prostate and the treatment is applied to promote drainage of the infected prostatic secretion. It has seemed to me to be of value in the occasional case in which there is gross infection of the prostate with pocketing of pus as shown by attacks of fever combined with symptoms such as aching pain in the perineum or groins. In such cases the massage should be carried out gently not more than once a week. I have never been convinced of the value of routine prostatic massage given once or twice a week, or more often, in the treatment of chronic symptomless prostatitis whether associated with metastatic infection or not.

Sulphonamides.—All but six of the patients in the present series received one or more courses of sulphapyridine, the amount given varying from 18 g. to 49 g. and the period of administration varying from three to fourteen days, the largest amount given in any one full day of treatment was 10 g. and the smallest 3 g. Eight patients received a course of sulphanilamide in addition. A small group, which was treated with mechanically induced high fever received sulphonamide in the eighteen hours preceding fever-either 10 g. or sulphanilamide, 6 g. of sulphapyridine or 7 g. of sulphathiazole. Sulphapyridine was used in preference to sulphanilamide as being the more effective drug. Extensive use of sulphathiazole has been prevented by the fact that this drug is in short supply. The tesults obtained by the administration of sulphonamides in these metastatic cases have been unimpressive. Certainly none has shown striking improvement. When improvement has occurred the extent to which the sulphonamides have contributed to this has been difficult to assess. In some cases the signs have indicated diminution of the severity of the urethral infection, but there has been no concomitant improvement of affected joints or fasciæ. The causative focus of infection in such cases is likely to be in the prostate or seminal vesicles and experience has shown that severe infection of these organs is often very resistant to sulphonamide therapy. Other workers have claimed much more satisfactory results from use of the sulphonamides.

In view of our failure to obtain good results we consider that the combination of high fever with sulphonamides is a more promising field for investigation, but again the relative

values of two treatments applied simultaneously are very difficult to assess.

Protein shock.—40 of these patients were treated with fever induced by the intravenous injection of stock T.A.B. vaccine and the results were assessed in a recent paper by Nicol (1942). He found that the best results were obtained in those patients, 30 in number, who developed metastatic lesions during or soon after the administration of sulphonamide preparations. 25 of these patients were cured and 5 were improved as a result of this treatment. Those patients who developed metastatic lesions before treatment was begun made a less satisfactory response. The pain was relieved in most cases but usually the improvement was only temporary—of the 10 patients in this group 3 showed considerable improvement, but the other 7, after temporary improvement, failed to respond. The probable explanation is that in the last group the spread of the infection was of longer standing. There is no doubt that the sooner pyrexial treatment is applied to these cases the better the chance of obtaining good results. Massive doses of T.A.B., such as 700 million organisms in a single dose were used at first. Most patients were given much smaller doses administered by the "Divided Dose" method. By this technique half the dose was given at first and the remainder after four hours, when the temperature had begun to rise from the first injection. The initial total dose was 50 million organisms. This modification gave more satisfactory results and the toxic effects were less severe. It was seldom possible to produce a rise of oral temperature to more than 104° F. by either of these methods.

Hyperthermy.-Mechanically produced high, prolonged fever has been claimed as a specific for the treatment of gonococcal arthritis and almost all the early reports indicate that 90% or more of patients were cured or markedly improved. Trautman (1940) stated that in a series of 129 patients suffering from gonococcal arthritis 117 or 879 cured or improved as the result of pyrexial treatment, and his figures in a more recent series (1942) are almost identical. Our earlier experience at the London Hospital in the treatment of recent cases of acute gonococcal arthritis with fever sessions of five to eight hours at 106° to 107° F. using the Kettering hypertherm were remarkably satisfactory and there were no failures in a small series. The number of patients treated in the present series is 16, a group which is small and very variable as to type and duration of infection, and from which no conclusions can be drawn. With one exception, a case of severe plantar fasciitis, all have been improved. Eight patients were suffering from chronic conditions of long standing in which complete cure was not to be expected. Two were cured and five remain under treatment having shown considerable improvement as a result of the fever sessions. Temperatures of 106° to 107° F. have been maintained for eight hours in each session and treatments have been repeated at intervals of five to seven days if required. The largest number of sessions given in any one case is six. Most of these patients were treated with fever alone, but in a few the fever sessions were preceded by the administration of sulphonamides. No assessment of the comparative value of fever alone and fever plus sulphonamide can be attempted. The treatment has its dangers and requires a high standard of nursing care for these dangers to be avoided. The more skilful and experienced the nursing the less likelihood of complications. The total number of patients who have received this treatment at this hospital is 110 and there has been one death from heat stroke. About half this number were previously treated at the London Hospital without a fatality.

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# Section of Urology

President-G. E. NELIGAN, M.C., F.R.C.S.

[April 23, 1942]

# Hæmospermia

By Geoffrey Parker, F.R.C.S.

The earliest reference which I can trace to the condition known as hæmospermia is made by Galen who observes that the over-use of any organ in the body makes it necessary to call upon the reserves of "humours" of the other organs. Ambroise Paré observed the condition but his comments are of no scientific value. Coming to more recent times Dalandeterie in 1813 reported two cases of hæmospermia in youths. Demarquay wrote a paper on hæmospermia (1863) and reported a case in a man of 26 with a hydrocele and epididymitis who was a masturbator. He collected four cases from the literature and attempted a classification, the value of which is negatived by later observations; he does, however, mention the interesting fact that hæmospermia may occur following orchidectomy, presumably from injury and bleeding into the stump of the vas on the operated side.

Hugues (1894) wrote an excellent paper on hæmospermia and included a large number of references. This is the first important scientific contribution to the subject that I could find. Hugues reports three cases, the first of which was associated with an urethropostatitis and fistula in ano, and the second with a stone impacted in the prostatic urethra. Both these cases had painful hæmospermia, and the third case was one of excessive masturbation. This author also gives a classification to which I have little to add. Hugues puts genital tuberculosis as the commonest cause, and at the end mentions that hæmospermia may also occur following the sudden arrest of rectal bleeding from piles. The venous connexion between the prostatic plexus and the hæmorrhoidal veins being an intimate one, if the factor, such as cirrhosis of the liver which caused the rectal bleeding, be still operating, then vesiculo-prostatic bleeding with hæmospermia may be expected. This seems to me a sound enough suggestion, but nobody since then has observed it.

In 1894 the first American publication that I can find on this subject appeared. Lydston reported five cases and considers that the commonest causes of hæmospermia are congestion behind a stricture, seminal vesiculitis and what he calls "unbridled license, short of physical indulgence".

In 1899 Jonathan Hutchinson reported the case of a man of 40 who had a four years' history of hæmospermia. The man had, and there was also a family history of, periodic purpuric rashes. There was no report of a urethroscopy having been done, and Hutchinson suggested a diagnosis of a small angioma in a seminal vesicle.

Chute in 1903 cites a case reported by Guelliot of a man who had eleven emissions in one afternoon and seven more the following day. Many of these latter being blood-stained, and Kroner records the symptom in a unique and fatal case, as the first manifestation of scurvy.

Nelken reported two cases in 1910 and for the first time puts forward the theory of "hæmorrhage ex vacuo" which is quoted and supported by many later authors.

This theory postulates that when an orgasm occurs after a period of prolonged continence, the over-distended vesicle is suddenly decompressed and a hæmorrhage occurs into it in the same way that it may occur if a distended urinary bladder or hydrocele have been too rapidly emptied surgically.

With respect to the many supporters of this theory I do not myself feel that there is much in it, because, while a man may have been continent for many years, it is common knowledge that the normal requirements of sexual life are expressed by involuntary nocturnal emissions which may after a time assume a periodicity in their frequency not unlike the menstrual cycle. There seems to me therefore little reason why prolonged abstinence should produce a pathological distension of the vesicle.

Shropshire, writing from St. Louis in 1912, draws a distinction between hæmospermia due to bleeding from the vesicles and the prostate. He says that when the blood comes

from the vesicles the semen will be uniformly stained pink or red, while if the bleeding is prostatic the semen will be streaked with blood and small clots. This is, I think, what one would expect and is in accordance with my personal observations.

Kenneth Walker (1923) considers that acute seminal vesiculitis is the commonest cause and genital tuberculosis the next commonest. He also mentions sexual excess and systemic blood diseases.

Marion (1935) has never himself seen a case of hæmospermia which was found to have a serious underlying disease as the cause, and has noted on the contrary that the condition tends to clear up spontaneously. He does, however, make a classification based on the literature.

Ashkar and Issa in 1935 reported seven cases of hæmospermia due to bilharziosis, the infection being of the hæmatobium type, with terminal spikes. In all cases the seminal vesicles only were affected and not the prostate; they also note that the vesicles are frequently found infected without hæmospermia ever occurring.

Dr. Parkes Weber had a case of a man who had hæmospermia for thirty years and the blood-stained ejaculations only finished when old age naturally terminated testicular

In the correspondence on the subject in the Brit. M. J. of November 9 (1940), a number of theories were put forward. These ranged from constipation to enlargement of the prostate and the male menopause, as possible causes of hæmospermia, but very little evidence was supplied in support of them.

Here is an account of five personal cases:

CASE I.—This is a simple case of trauma. The man was a homosexual of 66, who received a sharp squeeze in the right testicle.

Pain was immediate and very intense. He was sent to me by his doctor twenty-four hours later, still in very great pain, and in addition stated that he had had an emission during the night following the accident, presumably due to local stimulation by the injury. The semen had been dark red, as well as streaked with bright blood. On examination, the right testicle was exquisitely sensitive and could only be palpated with the utmost gentleness after giving \(\frac{1}{2}\) gr. of morphia intravenously. There was no discoloration of the scrotum and the testicle, still smooth and globular, and separable from the epidermis, was only a little larger than the left. There was a slight hydrocele. Rectal examination was negative.

The condition presumably was a hæmorrhage within the tunica albuginea and the great pain due to the rise in tension within that inelastic structure.

With rest in bed, cold local applications and morphia for the first two days the condition settled down, and a further emission ten days later was only slightly brown stained. Subsequent emissions were normal but there was still some testicular neuralgia six months later, presumably due to fibrosis round the nerve endings.

CASE II.—A young Spanish waiter gave a history of a sudden onset of hæmospermia not associated with pain or other symptoms. Every subsequent ejaculation over a period of ten days was blood-stained, and no emission had been tree from bright blood, in varying quantities.

There was no history of gonorrhea, the external genitalia were quite normal, as was also the prostate, and the vesicles were not palpable or tender. In view of what was subsequently found it is curious to note that the

urine was clear.



FIG. 1.-Case II.

Cysto-urethroscopy showed a normal bladder and bilateral clear effluxes. On the left side of the verumontanum near its base there was seen a simple papilloma differing in no respect from those commonly seen in the bladder. As the patient was a man with whom I could scarcely communicate by the spoken word, the examination was done under a general anaesthetic.

There was, therefore, no difficulty in this case in doing immediate fulguration through an operating urethroscope. No other papillomata were seen.

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There was slight hæmaturia on the night of operation, and since then, i.e. during the last eleven months, no more blood has been seen, in either the semen or the urine. One would have expected this man to have had hæmaturia as well as hæmospermia, but apparently prostatic engorgement was an essential feature of the event.

I propose to cysto-urethroscope him at regular intervals just as we do for vesical papillomata.

CASE III.—A married man of 60 had noticed blood in the sperm for the preceding four or five weeks. There was also nocturnal frequency up to four or five times, and hourly by day. No blood had been seen in the urine, and the immediate specimen was quite clear. There was a history of many attacks of gonorrhea. On examination there was a tense cystic swelling in the upper pole of the right epididymis and one right inguinal gland was enlarged. Per rectum there was some simple lateral lobe enlargement of the prostate.

On cystoscopy there was no intravesicle projection and no apparent source of bleeding.

On the verumontanum there was a large distended venule with a fresh blood-clot above it in relation to the

utriculus masculinus.

It was not obvious that bleeding was coming from the dilated venule and so I left it alone. I then tapped the spermatocele and found only the usual opalescent fluid. Cytological examination showed no red cells.

An emission a fortnight after tapping contained some stale blood and there was no further trouble until the spermatocele reformed, when the harmospermia again occurred.

With the fear always in my mind that I might be dealing with a very early carcinoma of the epididymis, in addition to the spermatocele, though admittedly this is a very rare condition, I advised operation and duly removed the spermatocele. The testicle itself appeared to be quite normal. I kept trace of this man for two years and there had been no return of the trouble.

I do not understand the mechanism of this case; I think it may well have been a simple congestive phenomenon and the cure produced by the removal of the spermatocele simply a coincidence.

CASE IV.—This seems to be the oddest of the four cases. It is that of a Russian, aged 42, who came to me complaining of difficulty and frequency of micturition and a poor stream, combined with hæmaturia, harmospermia and decreasing sexual power.

He also gave a history of frequent, spontaneous and very painful erections. There was some pain in the left testicle and inguinal canal. There was no history of gonorrhee and the Wassermann reaction was negative. The external genitalia appeared normal, as did also the prostate and vesicles, palpated per rectum.

On cystoscopy the bladder was normal, but in the prostatic urethra to the left of and encroaching on the verumontanum there was seen a cyst (fig. 2), which was probably about the size of a pea.



FIG. 2.-Case IV.

FIG. 3.-Case V.

It was covered by smooth shiny epithelium, over which small blood vessels were coursing. It looked very like

It was covered by smooth shiny epithelium, over which small blood vessels were coursing. It looked very like a simple ovarian cyst in miniature.

Through an operating urethroscope I pushed a sharp diathermy needle into the cyst and turned on the current. The cyst appeared almost to explode, and at once the instrument was blocked by a thick griatinous fluid not unlike normal semen.

After washing out the urethra I could see no trace whatever of the cyst or its contents, nor could any other cyst be seen under the mucous membrane of the reat of the prostatic urethra. Since operation there have been no further spontanous painful erections and no further harmaturia or harmospermia. That was in June 1938. Six months after operation he wrote saying that he had no further genito-uring trouble of any kind, but that normal sexual desire was still diminishing. Coitus occurred about once a month and hæmospermia had not occurred again. occurred again

I do not know the origin of this cyst but I imagine that this was mainly a mechanical problem as far as symptoms were concerned. The cyst no doubt blocked the ejaculatory ducts and produced congestion and back pressure in the vesicles and pain down the vas to the testicle. The hæmorrhage occurred probably into the vesicle and involuntary and unconscious contractions in the internal vesical sphincter, associated with the lesion itself as a sort of trigger mechanism, may well have been the exciting cause of the spontaneous erections.

CASE V.—This case was referred to me only five days ago. It is that of an unmarried man of 28, with a long history of active bilateral pulmonary tuberculosis and many hamoptyses. One week before I saw him he had had a nocturnal emission which was pink. There was no pain, but he awakened immediately afterwards, and found the pink seminal staining,

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Since the bleeding he had noticed a heavy feeling in both testicles and groins and down the inner side of the (s, which he described as like rheumatism.

He stated that he rarely masturbated and there was no history of urinary disturbance or frequency of

He stated that he rarely masturbated and there was no instory of urmary unitarities.

Per rectum the left vesicle was enlarged, hard, nodular and tender; the right vesicle was not palpable; the prostate was normal in size and shape and was not tender. The testes, epididymides, and vasa were normal. On cystoscopy I found the bladder normal, with clear effluxes from both kidneys.

The upper half of the prostatic urethra was normal, but the distal three-quarters of the verumontanum was covered by pale granulation tissue so that its shape could scarcely be determined, and on the distal slope of the verumontanum there was a shallow ulcer thinly covered with a greyish green slough, and the movements of the urethroscope in this area were painful even after instillation of 4 per cent. novocain. (See fig. 3, page 25.)

I propose to do a double vasectomy with injection of 10% carbolic into both vesicles via the cut vasa, as this seems to me a unique opportunity to save this man at least some of the inevitable miseries of genito-urinary tuberculosis,

I think it might be worth while to do a diathermy cauterization of the granulation tissue on and around the verumontanum. It seems to me likely that this is a very early case of hæmic spread from the lung lesion to the left vesicle with secondary involvement of the prostatic urethral mucosa.

Classification of the actiological factors in disease is very important. But there is a tendency in recent years to give percentages on too small a number of cases.

Here the majority of references to cases date back many decades, when the exact diagnosis was often unknown and mere surmise. Therefore it is not possible to-day to give more than an impression of what should be done and what is most likely to be found in cases of hæmospermia.

Scheme for case investigation: (1) History taken to elicit story of: (a) Masturbation; (b) sexual excess; (c) gonorrhæa; (d) associated local pain.
 (2) Examination of urine.
 (3) Rectal examination.
 (4) X-ray examination.
 (5) Cysto-urethroscopy.
 The condition most likely to be found in order of frequency would appear to be:

(1) Gross masturbation or sexual excess. (2) Tuberculous vesiculitis. (3) Acute vesiculitis, (4) Mechanical urethral obstruction, e.g. urethral irrespective of causal organism. stricture, calculi, prostatic cysts, and neoplasms, simple and malignant. (5) Chronic congestive vesiculitis of gonococcal origin (6) Prostatic congestion due to (a) Simple adenoma; (b) long-postponed orgasm. (7) Trauma, surgical or otherwise. (8) Blood diseases, e.g. leukæmia, purpura, and scurvy. (9) Rare possibilities, local and systemic; (a) Primary disease of the testicle and epididymis; (b) carcinoma of a seminal vesicle; (c) cirrhosis of the liver, with leak of portal system through prostatic plexus; (d) bilharzial vesiculitis.

I am much indebted to my house surgeon at the French Hospital, Dr. Galewski, for helpful suggestions and assistance with the German translations.

In the subsequent discussion, Mr. Clifford Morson and other speakers mentioned a number of cases which they had seen, where the hæmospermia appeared to be due to hypertension without any local disease, and relief of the hypertension cured the condition.

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# Section of Odontology

President-Harold Round, M.D.S.Birm., L.D.S.Eng.

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# Fractures of the Jaws: Should Teeth and Comminuted Bone be Removed?

By D. GREER WALKER, M.Dent.Sc., M.B.

A STUDY of the opinions held on this question shows a curious inconsistency: while the majority of dental surgeons seem to be in favour of removing teeth in the line of fracture, most of them think that badly comminuted bone should be conserved because its removal often leads to the necessity for bone grafting. Is the assumption that there is such a wide difference between teeth and comminuted bone justified and, when bone dies in the mandible, are the results so much less detrimental than those of dead teeth? I have included both subjects in this article because, while no one would assert that dead bone and teeth are identical in their behaviour, they have a good deal in common in certain cases.

There are some important factors which, indirectly, influence treatment: (a) The age and sex of the patient; there is a stronger case for preserving the front teeth in a young girl than in an elderly patient. Reluctance to extract teeth in children and young adults is accentuated by the fact that their mouths are freer from infection and healing is more rapid. (b) The personal wishes of the patient cannot be entirely disregarded: some people are unwilling to part with their teeth, particularly incisors, and while treatment should not be prejudiced on this account, an attempt should be made to save them if there is a reasonable chance of a good result. (c) When other injuries occur in conjunction with jaw fractures, surgical dental treatment may have to be postponed or curtailed: the most serious injury must naturally be treated first, but this is no reason for complete neglect of the fractured mandible, and one of the simpler forms of immobilization can generally be carried out. The circumstances in which preliminary treatment can be given vary considerably: at advanced dressing stations, for instance, it is impossible to give more than first aid, and a suitable form of treatment can only be planned and carried out when the patient reaches the base hospital. While extractions that appear inevitable should be done as soon as possible, no tooth, unless it is so loose that it can very easily be removed, should be extracted unless some stable form of fixation can be applied. Great harm may result, particularly if the extraction is difficult and portions of roots have been left. Such preliminary treatment turns what might have been a simple issue intoa complicated one. The factors which have a more direct influence on treatment are: I.—The exact relation of the teeth to the fracture. II.—Condition of the teeth. III.—Condition of the bone. IV.-Value and interpretation of radiograms. V.-The age of the fracture when treatment is begun and the influence of this on the treatment.

#### I.—THE EXACT RELATION OF THE TEETH TO THE FRACTURE (Illustrations on p. 23)

Carious and infected teeth that are not directly involved in the line of fracture should be retained as they may be an invaluable aid in splinting the jaw. When a fracture occurs in the body of the mandible it may not directly communicate with the tooth complex but there are many cases in which the socket of the tooth is actually involved. In Case 1 the fracture is between the 45 but does not communicate with either: in Case 2 the radiogram and drawing show that the socket of the 4 is definitely fractured. This does not refute the argument that the tooth complex is stronger than the bone, but rather shows that in certain cases the force causing the fracture is so applied that its maximum effect falls upon the tooth socket. It is obvious that the premolars should be retained in Case 1 while in Case 2 the 4 should be extracted because of the direct involvement of the socket. Case 3 is interesting because bone can be seen on the anterior surface of the 7, the tooth complex remaining intact while the apex of the 5 is lying denuded of its socket in the anterior fracture line. The 7 was retained in this case because it did not communicate with the fracture, but the 15 was extracted. These three

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cases illustrate the need of finding out whether there is any connexion between the teeth and the fracture, but this is sometimes extremely difficult and radiograms may be entirely deceptive, which may account for the dictum that the teeth on both sides of the fracture line should be removed. In some cases this may be indicated but I do not think it should necessarily be the routine treatment. In Case 4 there is an obvious fracture in the | 4 region: this tooth was removed and, after some decalcification had occurred, a radiogram showed that the 3 was also involved. This fracture might be described as subperiosteal: one tooth in the line was retained and the other was extracted and healing was uneventful. Until some decalcification has occurred the exact extent of some of these fractures may not be apparent, and a routine "follow up" of radiograms should be carried out in all cases. Case 5 shows a fracture between the 87 teeth, the third molar being involved while the second was not: the theory that the third molar should be kept for a short time to assist in control of the posterior fragment was followed with disastrous results. Control of the posterior fragment should not be allowed to influence the decision in favour of retaining this tooth if extraction is the better course on principle. It may seem bold to take this view since the introduction of the "pin" method of immobilization but I think the tooth should only be kept if the other reasons for doing so are decisive.

Conclusions.—It should first be ascertained whether the teeth are definitely involved in the fracture and if they are, the relative merits of retaining or extracting them should be carefully weighed. If there is a tooth in the posterior fragment, its utility for the purpose of control should not be allowed to override all considerations in favour of extraction.

## II.—CONDITION OF THE TEETH (Illustrations on pp. 23-26)

There are four aspects of considerable importance in treatment: Extent of the trauma, degree of infection, stage of development and eruption.

Trauma.—Teeth subjected to injury may have either their roots or their crowns fractured. Case 6 demonstrates a fracture in the third molar region, the anterior root of this tooth being broken, and there was definite communication between the root and the fracture. Both tooth and root were carefully removed with any loose pieces of alveolar bone likely to sequestrate and radiogram 6 B, taken five weeks later, shows a satisfactory The risk entailed in keeping such a tooth far outweighs its possible use in preliminary control of the posterior fragment. Fracture of the crown of the tooth is a more obvious injury, and when this occurs the pulp cavity is open to infection. In Case 7 the crowns of the 654 were knocked off by a piece of shell which also caused a slight subperiosteal fracture, and, assuming that there was connexion between the teeth and the fracture, the question arose as to whether these pulp cavities, when they became infected, would prejudice the treatment. I think a fracture of this type should heal quickly enough to become "sealed off" before any infection can reach it from the pulp canal and, when the canals are left open, they are less likely to give rise to acute infection. The roots, if they are left, can be removed after about three weeks when the fracture is partially united and unlikely to take any harm in the process. The trauma caused by removing them immediately would be more detrimental than the danger of keeping them for three weeks: actually in this case it was impossible to contemplate extraction at an earlier stage because of the patient's other injuries. Radiogram 7 B, taken five months later, shows that union was complete. Case 8 A shows a large decalcified zone with the root of the 5 on the anterior margin. The delayed union seen in this radiogram, which was taken on admission to hospital six months after the injury, should not be ascribed t delay in removing the root so much as to lack of adequate immobilization: cases like this demand a long period of fixation which ought not to be curtailed or interfered with, and although extraction of the root and treatment for infection was undoubtedly the right course, fixation was even more important. Recalcification is seen in 8 B taken after the jaw had been immobilized for two months: the laying down of bone is obvious in the "lipping" of the lower border. In Case 9 extraction of the third molar had been attempted under an anæsthetic, but the anterior root was left behind and no fixation was provided. The patient was admitted to hospital a week later with much swelling of the jaw: the root was then removed and the jaw was fixed to the upper teeth for two and a half months. Radiogram 9 B was taken four weeks after this. Such a long period of immobilization was unnecessary from the point of view of union, but it was prolonged for the purpose of hastening and observing the recalcification, which is shown in 9 C, taken three months after the injury, to be almost complete.

Conclusions.—These four cases demonstrate fractures with broken teeth in which the treatment was successful, but we cannot assume that removal is always the better course.

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In similar fractures small apices might be left with safety, and this would certainly appear advisable if the difficulty of extraction is likely to outweigh the reasons for it. It is obvious that extraction of teeth in a badly comminuted fracture is much easier than in one of the subperiosteal variety.

Infection.—The degree of infection in the teeth is closely bound up with similar changes in adjacent bone, so we must consider also, at this stage, all infection specially connected with the teeth that is actually in the bone. Case 10 A shows a subperiosteal fracture extending obliquely backwards from the 8 to the angle of the jaw, and there appeared to be connexion with the apical infection of the last molar. The second molar was also badly infected but this was not involved in the fracture. The relation of the infected zones is clearly shown in the drawing. Because the fracture was subperiosteal, it passed through the bony wall of the abscess cavity and did not in fact communicate with the chronic inflammatory tissues: if it had been displaced, these tissues would have been disrupted and the infection directly connected with it. When there is no displacement I think the teeth may safely be retained in such a case until the fracture sealed off", and removed after immobilization has been in progress for at least three In Case 10 extraction was postponed so as to find out whether the presence of the teeth would retard recalcification of the fracture, but it did not appear to have done so: they were removed after three months, and radiogram 10 B, taken just before this was done, shows a good result. Case 11 was admitted to hospital with swelling of the jaw which had appeared a few days before admission: the jaw had been fractured six weeks previously but had had no treatment. A fracture line apparently involving the third molar is seen in 11 A and lack of immobilization had led to slightly increased The 8 was partially erupted, the anterior cusps just showing, and no decalcification. movement of the fragments could be detected. The history showed that the original traumatic swelling had disappeared one week after the injury, but a certain degree of trismus had remained. This was a predisposing cause of the flare of infection underneath an already infected gingival flap which caused the later swelling evident on admission. As in Case 10, the fracture skirted the zone of infection and, as the injury was already of six weeks' duration and the fracture partially united, all that was required was treatment for the infected wisdom tooth, which was extracted with care: radiogram 11 B. Case 12 was an unusual fracture of the symphysis which had been weakened by a large cystic cavity in that region. Radiograms A and B show the cyst and considerable apical infection of the adjacent teeth: neither this nor the cyst is in communication with the fracture. The cystic cavity was not opened, the teeth were retained, and the mandible was immobilized for five weeks: a good result is seen in radiograms 12 C and D, taken two months later. This case might have been complicated if the teeth had been removed and the cyst cavity opened.

Conclusions.—It is of paramount importance to decide whether infections such as those evident in the last three cases are connected with the line of fracture or separated from it by a thick layer of chronic inflammatory tissue through which the enclosed infection cannot pass. It would, of course, be a mistake to leave teeth if the infection connected with them has direct access to the fracture but in my experience this occurs only when the fragments are displaced, thus causing rupture of the inflammatory tissues. In subperiosteal fractures a better result is likely to be obtained by postponing extraction until the fracture is "sealed off".

Stage of development and eruption of the teeth.—These present two different problems: first we have the various stages of development in children's teeth and secondly, in older patients, partially or completely uncrupted teeth which, although fully formed, have been prevented for some reason from coming into alignment with the others.

Fractures of the mandible are rare in children and their mouths are comparatively tree from infection, which no doubt partly accounts for the characteristic rapidity in bony repair. Case 13 was a child of 9 who had, among other injuries, a bilateral fracture in the 7 | 3 regions: there was a little displacement on the right side but none on the left. Radiograms A and B show the fractures and in particular the unerupted teeth concerned. It was thought inadvisable to remove these, and immobilization produced a very satisfactory result as can be seen in 13 C and D, taken a couple of months later. Early treatment undoubtedly contributed largely to the success in this case but the effect of delay is obvious in Case 14. This child, aged 9, was admitted to hospital six weeks after her jaw had been fractured. The infection then evident was due to the developing | 7 which had been displaced so that it was lying between the lingual periosteum and the bone: this tooth had not been removed nor had adequate immobilization been applied. In this case removal of the displaced tooth and fixation of the fracture would probably have been the best immediate treatment and delay caused considerable infection

in the bone, so that when the case was treated eventually, it appeared necessary to remove not only the displaced tooth but the first molar also. Sequestration followed (14 B) and the result, shown in 14 C, was non-union. Whatever treatment had been applied after six weeks it is doubtful whether union would have taken place; but I think that while it was right to extract the first molar, it would have been better to wait until the infection was under control. Permanent teeth differ from deciduous teeth in that they occupy a relatively larger area of the mandible. This is especially true of the first molar, whose removal is likely to cause a good deal of trauma and open up a large surface of bone to infection if the fracture has already become infected. Case 15, a boy of 14, fractured his jaw through the 8 3 regions and the anterior fragment was displaced slightly downwards. The fracture was reduced and the jaw fixed for four weeks by wiring the teeth together but the teeth were not removed. The unerupted 8 had no adverse effect on union, which took place uneventfully. If this case had not had immediate treatment and infection had developed, the result might have been similar to that in Case 14. Cases 16 and 17 show fractures through the third molar region in adults, this tooth being unerupted in both. It is clear that the trauma involved in removing these fully formed and deeply embedded teeth would constitute a graver danger than that of retaining them, which is only a potential one. Unerupted teeth in adults should generally be retained in the simpler fractures, at all events for a time; but in the more severe types it is often found that the reasons in favour of extracting these teeth are so strong that they outweigh consideration of the harm caused by additional trauma.

Conclusions.—Broadly speaking, a conservative line of treatment is indicated in fractures involving developing and unerupted teeth. The former may be regarded as free from infection and unlikely to cause trouble: the latter may be retained at some risk but this is more than counterbalanced by the trauma that would result in removing them.

## III.—CONDITION OF THE BONE (Illustrations on pp. 27, 28)

Fractures of the jaw have been described as partial and complete, and under this classification I shall briefly discuss five cases of partial or alveolar fractures before pro-

ceeding to the more important type.

Partial fractures.—These in everyday life are almost invariably alveolar; but in war time we meet with cases in which part of the lower border of the mandible is shot away although there is still continuity in the upper part of the bone. The latter type has little bearing on the subject under discussion as repair is generally uneventful. It is only in war injuries that cases of alveolar fractures are seen with much comminution and loss of bone and teeth. With extensive damage of this kind a careful débridement should be carried out and all pieces of tooth, damaged teeth and loose pieces of alveolar bone removed. When the case is seen immediately after the injury this operation may be accompanied by suturing of the gum: in some cases seen at a later date when infection has developed, it is wiser to control the infection before intervening surgically. There are, however, many cases in which damage is not so extensive as to call for removal of teeth. Alveolar fractures are more common in the maxilla than the mandible where the incisor region is the only part likely to be fractured. In those of the maxilla there is a more favourable prognosis with regard to the teeth as can be seen in Case 18. This patient, aged 22, was kicked in the mouth by a horse, causing a depressed fracture of the alveolus in the 432 region. The teeth were displaced en bloc inside the bite and the crown of the l was broken, but the apices of all remained intact (18 A). The fracture was reduced the following day and a splint was cemented to the upper teeth (18 B) and kept in situ for three months. The pulp canals were not filled until some months later so as to find out if this delay would have any adverse effect on the healing of the fracture: satisfactory union is seen in 18 C, taken shortly after the canals were filled. In such cases a more correct procedure, and one minimizing infection, would be to devitalize these teeth at the time of reduction, filling the pulp canals but postponing apicoectomy for consideration later. Case 19 shows an uncommon fracture of the mandible: this patient, aged 20, was kicked in the front of the mouth while playing football and sustained a transverse fracture of the alveolus across the symphysis. The four incisors which were lingual to the canines were displaced labially en bloc. A splint was cemented in position the following morning, but the impacted displacement was not corrected as it produced no abnormal occlusion apart from an edge to edge bite, and added trauma might well have led to the loss of the teeth. The splint remained in position for two and a half months, a period that might have been shortened, but it was thought best to err on the safe side. Radiograms 19 B and C, taken six months and a year later, show no evidence of infection and the

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result was clinically satisfactory. Posterior alveolar fractures occurring in the maxilla have the added complication of close proximity to the antrum, and in removing the teeth related to them there is a danger of establishing connexion between the antrum and the mouth. Actually the line of fracture does not involve the apices of these teeth, the outer and palatal walls of the antrum being broken instead. Case 20 shows a fracture in the 87654 region caused by a blow: the teeth in this broken fragment were not removed and the jaw was splinted for seven weeks, at the end of which time it seemed unnecessary to extract them. Cases 18, 19 and 20 were all young people with healthy teeth and conservative treatment appeared to be justified; but in Case 21, a patient aged 40 with a fracture of the |123456 region, there was considerable gingival and apical infection. Here, apart from the injury, removal of the teeth was long overdue and those involved in the fracture were extracted with the fractured portion of the alveolus. Radiogram 21 B, taken a couple of years later, shows that a considerable loss of bone was involved in this While it was obviously necessary to remove these teeth, I think it would operation. have been wiser to try to preserve so large a fragment and this could probably have been achieved by extracting the infected roots immediately but postponing removal of the other teeth until there was some union in the fracture. In Case 21 infection was present before the injury, but Case 22 demonstrates the marked degree that may develop afterwards. In this both teeth and alveolus were fractured in the 321 123 region (22 B) and there was also a fracture in the 32 region of the mandible (22 A and C). When I first saw this case after six weeks, all these teeth were loose and there was a good deal of infection in the bone: the extent of the injury made retention of the teeth a very doubtful proposition and, when infection was added to this, it became imperative that the teeth, portions of roots and sequestrated bone should all be removed as soon as possible. Following this operation progress was good but the inevitable delay in union caused by infection is seen in radiogram 22 D, taken after six months.

Conclusions.—In extensive alveolar fractures there are usually strong indications for extraction, particularly when they are associated with infection; but the teeth may safely be retained in cases that are not of a serious nature. If large portions of the alveolus are fractured, as few teeth as possible should be removed until some union has taken place.

Complete fractures.—It is sometimes difficult in the less severe cases to determine whether fractures of the mandible are simple or compound, but it is generally assumed that the majority are compound. I think that in certain fissure or stellate fractures there is no rupture of the soft tissues and no communication with the mouth; and these might therefore be more correctly classed as simple or subperiosteal fractures. Case 23 was struck on the side of the jaw by a landing aircraft: on admission there was pain and tenderness in the region of the blow but all other clinical signs of a fracture were absent. Radiogram 23, taken six weeks after the accident, shows a good example of the stellate type: in all probability it had no communication with the oral cavity and there was no need to extract the teeth. This kind of fracture is rare: the common type met with in civil life is the uncomminuted fracture of the mandible with a vertical or oblique fracture line, the displacement depending upon the site. The problem in both is primarily that of the relation of the teeth to the fracture and it is unnecessary to add to what has already been said on the matter. In comminuted fractures and those with loss of bony tissue the extent of damage to the bone is of an extremely varied character and the second problem under discussion, "should comminuted bone be removed", begins to arise. I must therefore give a more detailed account of the following cases. We have already discussed the comminuted alveolar fracture and its treatment: there are two other types, the one in which the main damage is to the lower border of the mandible and the other with fragmentation distributed more or less evenly throughout the body (Case 24). This man was struck on the chin by a piece of shell and when he was admitted to hospital five days later the lower anterior teeth were painful and there was a large hæmatoma under the tongue, but no tear in the buccal mucosa. Apart from a four-tailed bandage no form of immobilization had been applied. Occlusion of the teeth had not been disturbed. The metal had not entered the mandible: the wound had been allowed to close and drainage had not been maintained. Radiogram 24 shows extensive comminution of the anterior part of the mandible, the damage being more severe in the lower part of the symphysis. It is commonly supposed that union in alveolar bone is rare and that since this part of the mandible is transient, it is unnecessary to attach much importance to preserving it, but we must apply this theory with some reservation. In Case 24 I would confine extractions to a minimum as the alveolar bone may be the only existing link in continuity if the smaller fragments concerned in the fracture should sequestrate. Apart from this reason, if all the teeth near the fracture were removed it would entail loss of the 54321 12345 which would open up a very large bony surface in a fracture that

had already become infected. In a case of this kind it is better to immobilize the fracture and treat the infection before extracting the teeth, and drainage should be established as a routine procedure for sequestration is certain to occur. This policy was carried out in Case 24. When it was thought opportune, a month later, the four incisors were extracted and subsequently the canine also. The result was bony union. Treatment in Case 25 was a difficult problem as the possibility of union was doubtful, and I think it is worth while to discuss the alternatives that presented themselves. This case was a young girl of 20 who received a penetrating wound of the right cheek, the bomb fragment lodging in the mandible. This and several pieces of bone were removed shortly after the injury and the wound was sutured: the teeth were then wired together with eyelet wiring. Six days later the wound in the cheek seemed to be healing normally and there was little clinical evidence of active infection in the mandible, but in spite of this apparently favourable clinical picture, radiogram 25 showed loss of part of the lower border and severe damage in the tooth-bearing area of the 76543 , the 4 being dislocated out of its socket. The first thing to be decided in this case was whether there was any ultimate possibility of bony union. If this question could be answered in the affirmative the obvious treatment would be extraction of the 754 with any small pieces of alveolar bone, and immobilization of the jaw. But the fact that the 8 was unerupted made control of the posterior fragment impossible and this was a definite handicap in the treatment. It might be argued that the 7 | could be kept for a time for this purpose, but the value of keeping it would probably be outweighed by its potential danger; and for how long in any case could it be retained? This question can be answered by consideration of the fact that the fracture would obviously need a long period of immobilization and the 7 could only be kept for a fraction of this time. If this conservative line were followed and sequestration allowed to take its course, the result might be union or it might not, and in these circumstances would not radical treatment be the surer method? think that the loss of the lower border of the mandible coupled with fracture of the alveolus and the problem of controlling the posterior fragment turned the scale in favour of performing a radical débridement as soon as possible, as this would at least secure healthy bone ends for an early graft. Case 26 emphasizes the importance of decisive treatment. This man was admitted to hospital with a fractured mandible caused by a bullet which entered the cheek as seen in radiogram 26 A. There was no apparent laceration of the mucous membrane and occlusion was undisturbed. First the bullet was removed, dependent drainage was established and the 2, of which the crown had been badly broken, was extracted: secondly, seven days later, it was thought necessary to remove the 543 | also, with the alveolar bone islet; and lastly, four weeks later, some sequestra were removed. One might justly ask whether all these operations were essential within five weeks or if it would not have been better to include them all in one at the outset, and immobilize the jaw without further interference. While one school of opinion might advocate a minimum of surgical intervention in the early stages of this case, another would prefer to remove the 5432 immediately and possibly the alveolar bone also. In a case of this kind it is essential that the treatment should be carefully planned.

In comminuted fractures the decision as to which teeth should be extracted, and how much bone removed, is by no means easy. It rests primarily upon whether a graft is likely to be necessary or not. The maxim that no bone should be removed is firmly rooted because the possibility of union, however remote, is generally present. Treatment on this assumption is justified in many cases, but there are others in which it is obvious from the very beginning that bone grafts are inevitable, and sequestration simply delays and complicates the issue. However strongly we may hold this radical point of view it would be rash to dogmatize, as there are borderline cases in which the pros and cons are too evenly weighted for a fair decision: in these I think the policy of temporization is justified until the stage of sequestration is reached, when the condition should be carefully considered and, if sequestration is unduly severe and prolonged, the radical method of treatment should be adopted. Case 27 is an example of what might be termed the borderline type. This patient had multiple wounds: the foreign body seen in the radiogram was in the tongue, and the entry wound in the jaw was kept open and "through and through" drainage established. No teeth were involved in the fracture and at first there seemed to be a reasonable chance of union, but radiograms 27 B and C, taken at intervals of two and seven weeks respectively, showed that the condition was becoming progressively worse. It was then decided that a bone graft could not be avoided and the sequestra between the fractured ends of the bone were removed as seen in 27 D; this procedure undoubtedly limited the period of infection. In looking back, I think this treatment might with advantage have been applied some weeks earlier. The wait and see policy can be carried too far.

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Conclusions.—The general tendency towards conservatism in removal of comminuted bone is sound provided that the comminution is not too extensive and there is no gross loss of bony tissue. It is important that a decisive line of treatment should be followed and each case should be treated without prejudice. The simple ones respond to conservative methods while the period of treatment in those associated with loss of bone may be considerably shortened by radical débridement.

## IV.—VALUE AND INTERPRETATION OF RADIOGRAMS (Illustrations on p. 29)

The help of radiograms in establishing the exact injury and extent of damage to the bone is easily perceived, but a point to which we perhaps pay rather less attention is the degree of decalcification that can be seen in connexion with some fractures, and its significance. This decalcification may be caused by lack of adequate immobilization and resulting traumatic hyperæmia, but in other cases infection undoubtedly plays an important rôle and accounts for the infective type. In the mandible we generally find that prolonged trauma in the fracture, caused by lack of suitable immobilization, leads to an early onset of infection. The following three cases are good examples of extensive decalcification. Case 28: this man fell from a window seven feet high and was admitted to hospital with concussion, but a jaw fracture seems to have been undetected as no treatment was given. After returning home he developed a swelling and when I saw him six weeks after the injury, this was of considerable size. Occlusion was undisturbed but abnormal movement in the 3 region suggested a fracture: radiogram 28 A confirmed this and showed an excessive degree of decalcification. The patient was admitted and after a splint had been cemented to the lower teeth the abscess was opened externally: eight days later, when infection was under control, the 3 was extracted and drainage was established by connecting the original abscess incision with the buccal sulcus adjacent to the socket. In this type of case with acute infection the sequence of the treatment is very important: the fracture should first be immobilized and secondly the infection controlled by adequate drainage, and only after this should any teeth that may be detrimental to the result be removed. The case is different if infection is not acute, as in chronic sinuses: here there is little danger in removing the teeth and establishing drainage at the same time, once the jaw has been immobilized. In Case 28 it might be assumed that the premolar should be extracted as well as the 3. If the decalcification were chiefly infective this would probably be advisable, but when trauma has played so large a part for as long as six weeks it is found that recalcification will probably take place around this tooth, as shown in radiograms 28 B and C, taken ten weeks and twelve months after immobilization was begun. In this instance the jaw was splinted for three months: delay in union was caused primarily by increased and prolonged trauma and secondarily by infection. The prognosis in such cases is good if adequate immobilization and elimination of infection are rigidly carried out. Case 29 was an epileptic who fell and struck his chin on the ground. He attended hospital next day with some swelling of the jaw, but no obvious movement of the fragments. Radiogram 29 A showed a fracture involving the 5 region, this tooth being uncrupted and lying vertical in the body of the mandible. In view of the nature of this fracture it was thought inadvisable to extract the tooth but construction of a splint was begun: the patient, however, did not return to hospital to have it cemented in position until three weeks later when the swelling had increased. After the jaw had been immobilized the abscess was opened externally but the tooth was not extracted until some time after the infection had been controlled and the splint had to be removed and another one made to replace it. The first mistake was lack of care in planning the treatment and it taught me to refrain from including in the splint any doubtful teeth or from covering over any that are unerupted, for these cannot be removed with it in situ. The second mistake was in leaving the tooth so long. The problem here was twofold: in the early stages of the fracture the trauma caused by removing the tooth would have been too extensive to justify this procedure. The development of severe infection on the other hand indicated early extraction; but a better balance might have been struck between the two courses and the tooth should have been removed at the earliest possible moment after infection was under control. Mismanagement of immobilization and delay in extraction retarded bony union and radiogram 29 B shows a large zone of decalcification four months later which might be mistaken for non-union, the edges of the fragments tending to become rounded off. Fixation had to be prolonged to nine months and 29 C shows the extent of recalcification sixteen months after the injury: the almost eburnated ends of the fragments can still be seen surrounding the new bone and it is interesting to see recalcification in the alveolar bone also. Case 30 fractured his jaw in the 3 region by a fall and had attended a hospital where a splint had been cemented to the lower teeth: he had returned ten days later with a swelling in the region of the fracture and one week later the | 4 had been extracted and the abscess opened externally. When I first saw him six weeks after the accident it appeared from the history that at some stage in the treatment the original splint had been replaced by an arch wire method of fixation which was still in situ. Acute infection was still present and the original abscess incision was still discharging. Radiogram 30 A showed changes indicating an acute infective condition of the bone and there was a chronic apical abscess at the root of the | 5. A week later the infection appeared clinically to have subsided and it was thought safe to extract the | 35, but this was followed by a very acute condition characteristic of osteomyelitis, involving both sides of the mandible: 30 B, three weeks later, showed the extent of the infection on the same side as the fracture. In 30 C, taken after an interval of six months, recalcification was evident but it was incomplete in the lower border and a zone of residual infection appeared in the form of a cavity around the | 8. The lesson to be learned from this case is that extreme caution should be observed in the removal of teeth when decalcification is the result of an acute infective process rather than of traumatic origin.

Conclusions.—The value of radiograms in the treatment of fractures is not limited to showing the extent of the trauma: they are essential also on account of the subsequent changes they may indicate, and of these the most important is that of infection. Due attention should be paid to abnormal decalcification even in the absence of corroborative

clinical findings.

V.—The Age of the Fracture when Treatment is Begun and the Influence of this on the Treatment (Illustrations on pp. 30-32)

A rough analysis of jaw fractures at the present time shows that while many cases are admitted to a maxillo-facial centre within twenty-four hours of the accident there are others in which various reasons make it impossible to transfer them to one of these hospitals until some time has elapsed. Variations in the time between injury and

admission must necessarily influence the treatment in each case.

Case 31, an air-raid casualty, was treated within a few hours of the injury by a mobile maxillo-facial team at a hospital some distance from the Centre. It is unfortunate that more cases cannot be seen as early as this, for immobilizing a fracture at this stage and working in a field where infection has not had time to develop opens up great possibilities in the treatment. In this case a missile of unknown type had caused extensive damage and loss of soft tissue and bone in the right cheek and underlying portion of the mandible which made radical débridement necessary. All fragments of teeth and bone were immediately removed except one large piece which was well attached to the soft tissues. Radiogram 31 A shows the extent of comminution before this operation and in B, taken three months later, the rounded ends of the two fragments can be seen with the retained portion of the lower border united to the anterior one. At this early stage it was a comparatively easy matter to perform the débridement through the cheek wound, but if the case had been admitted to the Centre some days after a primary suturing, it would have been impossible to do more than maintain or establish drainage and leave sequestration to take its course, thus delaying the final issue. Case 31 is exceptional: there is usually an interval of twenty-four hours or more before the patient is transferred which often means that he has already been anæsthetized for excision and suture of the wounds and the jaw may have been immobilized either then or later, when the patient has recovered from the anæsthetic. It would be unwise to repeat the anæsthetic for some days unless it is absolutely necessary, and this means delay in operative procedure. If immobilization is inadequate a more stable form can be applied in the interval, and drainage can be established by removing sutures in the most dependent end of any wounds related to the jaw. This, combined with chemotherapy, application of heat and irrigations to the mouth, should check developing infection. Case 32, a man of 36, was also an air-raid casualty. A laceration of the left cheek had been excised and sutured and the fracture in the left canine region supported by a suitable bandage. Radiogram 32 A showed a comminuted fracture of the 34 region with an islet of bone containing these two teeth. By the time this case reached the Centre twenty-four hours after the injury, a large hæmatoma had developed in the cheek wound: this could be only partially evacuated and drainage was established in the lower part of the wound, which was below the fracture. A cap splint was cemented to the teeth, heat was applied to the jaw and the mouth was irrigated. After four days all swelling had subsided and the wound was healthy, so 34 were removed along with the alveolar fragment. The wound in the mouth was packed open and there seemed to be no reason for establishing connexion between this

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and the external one. After this operation progress was uneventful and 32 B, taken two months later, showed good recalcification. The splint was now removed and bony union was clinically confirmed. Little can be said in favour of retaining teeth in such a case, but it is important when removing them to leave behind no portions of the alveolus that are likely to sequestrate and delay union: further, when a cavity of this kind is kept open with packing for a short time, the possibility of a blood-clot breaking down and

becoming a source of infection likely to interfere with healing is remote.

When there are more severe injuries than that of the jaw the patient may not be transferred until a week or ten days after the accident; and when they endanger life to a greater degree, this interval is necessarily much longer. Success in these cases largely depends upon the treatment given to the jaw fracture in the meantime, and this is well illustrated by Cases 33 and 34. Case 33 had an aeroplane crash which caused a fracture of the symphysis and a deep wound of the lower lip communicating with it: the 21 was knocked out of its socket. A couple of days after the accident a splint was cemented to the lower teeth and the patient was transferred eight days later, when all that could be seen was a slight discharge from the wound below the chin. Radiogram 33 A showed that there was an unerupted tooth involved in the fracture. Owing to the treatment so far carried out it was possible to operate two days after admission and the unerupted tooth and remaining incisors were extracted: it had been thought beforehand that two of the incisors might be saved but at the time it was found necessary to remove them all. They had been included in the splint, but this was achieved by cutting through the necks with a fissure bur and elevating the roots out of their sockets. The wound in the mouth with a fissure bur and elevating the roots out of their sockets. was packed and the one under the chin enlarged for better drainage. Radiogram 33 B, taken two and a half months later, showed an advanced stage of union and the splint was removed. There appears to be no advantage in connecting the submandibular drainage with the mouth unless infection is likely to persist for some time. Case 34 was a woman aged 35 who received multiple injuries during an air raid. After her head and chest injuries had been treated for five weeks she was transferred to the Jaw Centre with a fractured mandible in the right premolar region. This had not been satisfactorily immobilized with the result that there was a considerable amount of discharge from a sinus below the fracture, and radiogram 34 A showed decalcification and sequestration. A splint was cemented to the teeth and an operation was performed in which the external sinus was explored and many small fragments of bone were removed. The gum was then reflected over the fracture in the premolar region and the sequestrated alveolar fragments were removed. The wound was irrigated with saline and a piece of corrugated tubing was passed through into the mouth: after this had been left for a week it was reduced in length and frequent irrigations were given. Radiogram 34 B, taken three weeks later, showed that there were no loose fragments of bone remaining. I think it would have been incorrect to extract any teeth at the original operation as it would ur doubtedly have increased sequestration: if an infection of this kind is controlled first, fewer complications are likely to arise. It should be emphasized that in this case there was no curetting and very great care was taken in the removal of the sequestra. Three weeks later the adjacent teeth were extracted and bony union occurred in due course.

The reason for transferring a case to a Maxillo-Facial Centre after an interval of some months from the time of injury is generally delayed union which is caused either by inadequate immobilization or some persistent form of infection. Case 35 was sent to the Centre four months after he had been wounded by a bullet. The radiograms showed a fracture in the |456 region with evidence of delayed union and there was a cavity of residual infection at the alveolar end of the fracture. This type of case usually responds within a reasonable time to treatment consisting of immobilization followed by extraction of adjacent teeth and opening of the infective cavity into the mouth. As the infection was chronic in Case 35, all this was done in one operation. In old-standing injuries of this kind the period of fixation must be prolonged according to the degree

of delay in union, and any associated residual infection must be eradicated.

Conclusions.—In treating a case immediately after the injury the problem might be described as purely traumatic. After a short interval infection begins to play a major

part and due respect must be accorded to it.

Before concluding this paper I must make some reference to cases in which the results are atypical and also to the danger of basing assumptions as to the right line of treatment upon issues which, on a wider view, prove to be exceptional rather than general. A brief analysis of the two following cases may be of value as they are somewhat unusual. The first was treated on the maxim of retaining the teeth and the second on exactly the reverse. Case 36, a man of 46, had a fracture running obliquely through the right body of the mandible (radiogram 36 A) as well as bilateral fracture dislocations. The

fracture was badly compounded into the mouth but none of the teeth were loose. Only a few teeth were present in the maxilla and a splint was cemented to these, the lower teeth being wired to it for five weeks. Three weeks later the 85 were removed as it was thought they might be a potential danger, but union was unaffected by the presence of the others involved in the fracture (radiogram 36 B). At first sight this case seems to bear out the advisability of retaining teeth, but I think the successful result should partly be attributed to removal of the 851 and that the time of extraction, as in the next case, was a very important factor. The major problem in treating fractured jaws is not the method of immobilization so much as prevention of infection or how to deal with it when it has developed. Considering the type of fracture in both these cases, it is surprising that there was but little infection and union took place within a reasonable time. Case 37, a woman of 53, was an air-raid casualty with a comminuted fracture of the right mandible (radiogram 37 A) and lacerations of the face: when she was transferred to the Centre a week after the injury the wounds had been excised and sutured, the one relating to the fracture drained, and the jaw immobilized by eyelet wiring. Five days after admission there was little evidence of infection but the 8543 were extracted on principle, in case they should give rise to trouble, and radiograms 37 B and C, taken three weeks and four months later, showed a good result. This case might he cited in favour of extracting teeth in like circumstances but it should be noted that this was not done until twelve days after the injury and that the time factor referred to in connexion with Case 36 was partly responsible for the good result.

On reviewing over 300 cases for this paper, I have tried to show that it is unwise to dogmatize on the two subjects under discussion, and to plead for an open mind. In picking out cases to illustrate the need for a less rigid viewpoint in treatment I have made no attempt to cover the subject but simply to stress some of the more important considerations. The two main dangers likely to result from extraction of teeth are trauma and infection, but with bone, infection is our chief concern. In removing either it is most important to choose exactly the right time. With bone it has always been a fixed principle that this should be done either immediately after the injury or not until it has separated. The problem is less easy to solve in the case of teeth: in the early stages of a fracture the trauma caused by extraction is often a grave danger and later the best time depends upon the degree of infection present. I think it can be said of teeth in the line of fracture and comminuted bone in fractured jaws, that while we may hold a general bias in favour of one course or the other, we cannot be oblivious to the value of each in appropriate cases.

Some of these cases have been treated at the Maxillo-Facial Hospital at East Grinstead and for collaboration in the treatment I am indebted to my surgical and dental colleagues. I acknowledge permission from the Dental Surgeons at the Middlesex Hospital to include some of their cases, and to Mr. S. A. Riddett for one of his. My thanks are due to Professor Russ and the Medical Research Council for the invaluable help of Miss Clephan in reviewing the series of cases and the preparation and illustration of this paper.

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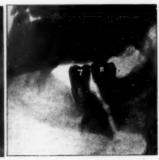












CASE 4

CASE 5





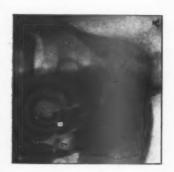


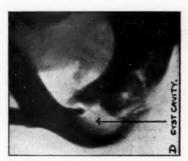
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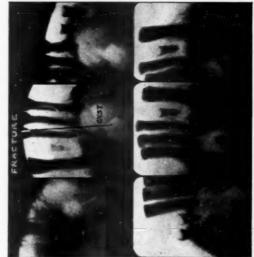








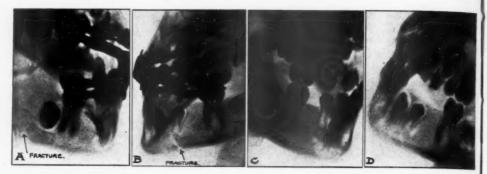




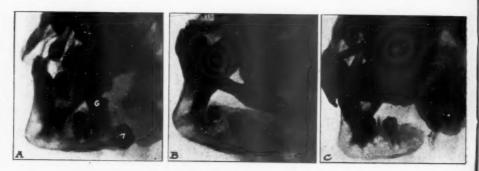




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CASE 13



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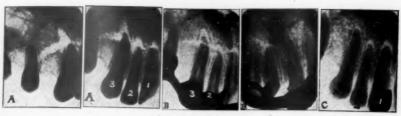
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CASE 16



CASE 17 (Mr. Warwick James)



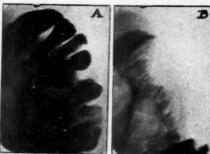
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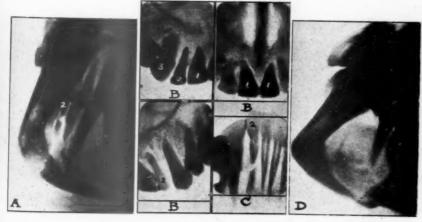
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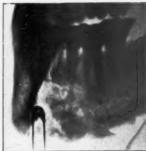
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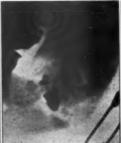
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CASE 26









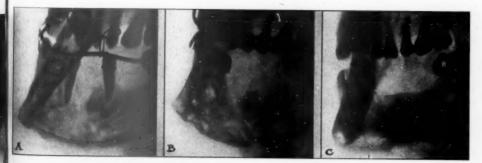
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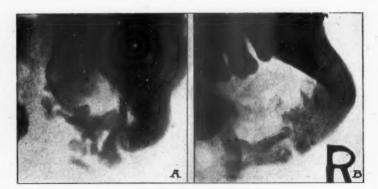
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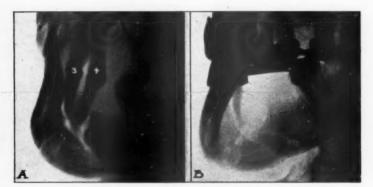
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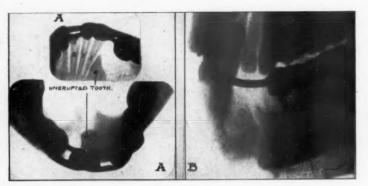
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CASE 31



CASE 32



CASE 33



CASE 36



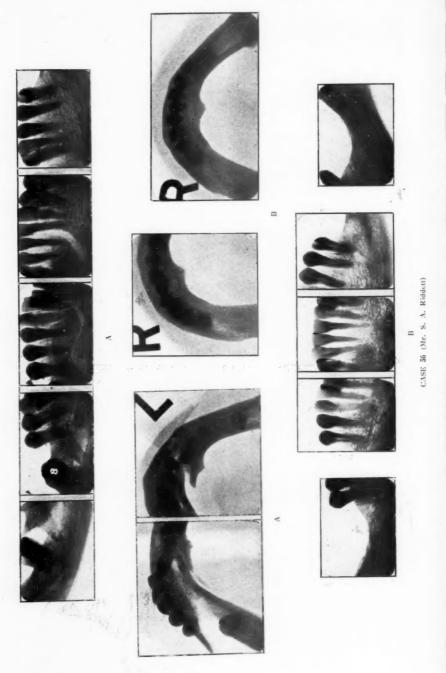
CASE 34



CASE 37







# Section for the Study of Disease in Children

President—A. G. Maitland-Jones, O.B.E., M.D. [March 28, 1942]

MEETING AT CELL BARNES HOSPITAL (St. BARTHOLOMEW'S), St. ALBANS

# The Place of Child Guidance in a Pædiatric Unit. [Summary]

By J. LOVEL BARNES, M.R.C.S.

AT Cell Barnes Hospital the Child Guidance Clinic is run in close co-operation with the Children's Department. The results have been very successful. The procedure has been for the psychiatrist to see cases that have already had a full physical investigation. The majority of children who have been investigated from this point of view have been suffering from asthma, enuresis, doubtful chorea, nervous tics and behaviour disturbances. The result of treatment in these cases has been very successful, particularly in those children suffering from asthma, in which a definite emotional factor was established.

children suffering from asthma, in which a definite emotional factor was established. An attempt has been made to assess the extent of the emotional factors, at the same time bearing in mind that in a certain percentage of them the physical factor may also be present. Where emotional factors have been detected, the children have either been treated in the out-patients' department at St. Bartholomew's Hospital, if they live in the London area, or in the Hertfordshire Child Guidance Clinic at Hill End Hospital.

London area, or in the Hertfordshire Child Guidance Clinic at Hill End Hospital.

A simplification of the methods of diagnosis and treatment has been attempted. Actually no very elaborate play material has been used and I have, in the case of the children treated at St. Bartholomew's Hospital, been working entirely on my own without even the assistance of a social worker. I stress this point in order that others who might be tempted to follow this experiment should not be dissuaded from so doing by the thought that a team of workers and a great deal of elaborate material must necessarily be forthcoming.

One of the simplest and most effective ways of getting a child to express ideas about which it is inarticulate, is to get that child to draw and fortunately this is a method which involves a minimum of material. Children's drawings were shown, illustrating

this point and also progress in treatment.

# The Surgical Treatment of Congenital Defects. [Summary]

By RAINSFORD MOWLEM, F.R.C.S.

The plastic surgeon's chief contact with pædiatrics is in the surgery of congenital defects. Not all require operations during early infancy but, as those who do are frequently in poor general condition, two main provisions are essential: the assistance of a skilled pædiatrician both before and after operation, and a surgical team accustomed to meet and deal with the special surgical and anæsthetic conditions of early infancy.

The optimum time for operation.—Most of the rarer congenital defects can safely be left to the later years. Hypospadias and epispadias do not usually call for intervention until about the age of 6 years. In the former the reason for delay is the necessity of constructing the urethra to ensure both rectal and sexual potency. Usually only minor degrees of epispadias lend themselves to plastic repair, the alternative being ureteric transplantation. Absence or atresia of the vagina may also be detected in childhood but is not operated upon until puberty. Syndactyly and polydactyly are usually operated on between the second and fourth year, unless further delay is necessary for identification of the primary centres of ossification.

Hæmangioma.—The small raised cavernous type with capillary elements on the surface, which appear after birth, are liable to spontaneous cure. The deep-seated truly cavernous type and the well-defined surface capillary type do not show such constant behaviour. The latter may improve, the former probably will not. The optimum treatment is either radium or X-ray, but the initial radio-sensitivity of these growths decreases fairly rapidly after the first year. It may not therefore be justifiable to await spontaneous cure when the treatment is so simple.

Cleft lips and palates.—In the repair of these conditions the primary necessity is the

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provision of a normal speech mechanism. Repair after "palatal speech" has been established is not sufficient to restore normal enunciation and a long period of speech training will be required. In my opinion this disadvantage can be eliminated by operating sufficiently early to enable the child to develop spontaneously good speech and sufficiently late to be safe. My own practice is to operate at the earliest possible time. Although the first forty-eight hours is said to be the best, this is rarely possible. If this opportunity is missed it is unwise to give an anæsthetic until nutritional advancement is well established. My own rule is to wait until the child weighs at least 10 lb. The repair of a complete cleft involving both lip and palate falls into two stages with an interval of three months between them, so that if it is hoped to complete surgical procedures before the end of the first year an early start is essential. With cleft of the lip only there is less urgency as there is no associated functional disability.

The disadvantages of such early intervention are chiefly increased technical difficulties. These can be overcome by the team which is accustomed to work on such small children but the team must be constant. In my own experience the mortality rate for a large series of cases is considerably less than 1%. In operations on isolated children in other parts of the country without the use of the usual team the mortality rate rose on one

occasion to 60%

The complications of early operation are chiefly respiratory. The great majority of small children show a reactionary temperature of as much as 100° F. on the day following operation. A few develop bronchitis, apparently due to nasal obstruction temporarily imposed by an adequate operation. Pneumonia is very rare. Both these complications can be reduced by confining the operations to the spring and summer months, necessitating postponement in some cases to a later period than would otherwise The risk of post-operative nasal infection which jeopardizes repair has be justifiable. been decreased by sulphanilamide which may be insufflated into the nose. Lastly a rare complication, not often stressed in this country, is hyperthermia pallida. I have met with six instances, the first fatal. The child's temperature rises extremely high in the first few hours after operation. It is pale, has a respiration rate between 50 and 90 per minute, an uncountable pulse, and if untreated soon dies from exhaustion. In the fatal case no significant post-mortem findings were discovered. Though atropine is assumed to have a bearing on this condition, as much as  $\frac{1}{50}$  of a grain has been given to one case without aggravating it. That it is due to so overloading the child in the theatre that its heat exchange mechanism is completely disorganized, is borne out by the lessened incidence since mackintoshes, pneumonia jackets and such impedimenta have been discarded. The treatment is to lower the temperature to about 97° F. by rectal wash-outs of ice water and to maintain it at that level for at least one hour. The heat-controlling centre apparently recovers and though there is usually a small spike of temperature on the next two or three days, the child's general condition remains good.

The difficulties encountered in operating upon small children are so great that success depends on close co-operation by the pædiatrician, in preparing the child for operation and advising treatment during convalescence, and the surgical team equipped to deal with structures which are minute and an organism which is intolerant of prolonged insult. Such a combination achieves good results and reduces the mortality rate to the minimum.

# Threadworms in Children in England. [Summary]

By MAY R. YOUNG, B.Sc.

THREADWORM, oxyuris or Enterobius vermicularis has man as its only natural host

and is found in persons of both low and high social status.

Fifty (42%) of 119 children in Cell Barnes Hospital (St. Bartholomew's) have proved positive for threadworms by the examination of three cellophane anal swabs per child, whilst two swabs per child revealed infestation in 22 (55%) of 40 resident London nursery

Necropsy material shows adult threadworms to be twice as frequent in the large as in the small intestine (Jones, 1941). The mature female passes out of the anus during relaxation and sleep to lay between 5,000 and 15,000 ova. By causing pruritus the eggs get on to clothing and fingers and if swallowed bring about reinfestation. Each ovum contains an infective larva which hatches out in the duodenum. After two months it reaches maturity, mates and passes down the intestine where it becomes attached to the mucosa by three labia at the oral end. Some may enter the appendix. Gordon (1933) on examination of over 26,000 appendices concluded that the threadworm is a negligible cause of appendicitis; whereas Wax and Cooper (1941) found Enterobius vermicularis in 8 out of 1,016 operative cases of appendicitis, 6 of these showing inflammatory reaction.

Diagnosis.—Threadworms may be seen either migrating or in the stool or microscopic ova found in the stool or on cellophane anal swabs. Considering the high incidence in children the finding of worms is rare; whilst 5% of the 119 children showed ova in the stools (three per child having been examined by zinc sulphate concentration flotation method) 42% of the 119 were positive by the examination of three cellophane anal swabs per child. This swab, designed by Hall in 1937, consists of a square inch of cellophane folded over the rounded end of a solid glass rod and held in place with a rubber band. Of the 119 children in St. Bartholomew's Hospital one swab per child revealed 26 positives, two swabs 40 and three swabs 50. American workers have shown that seven swabs per individual taken on alternate days reveal 99% of the total number of persons having threadworm infestation.

To compare the incidences in the two groups of children the examination of two swabs per child show 33.6% of the hospital children and 55% of the resident nursery school children to be positive. American workers have shown that treatment must accompany strict hygienic measures to eliminate threadworm infestation.

My acknowledgment and thanks are due to Professor R. T. Leiper of the London School of Hygiene and Tropical Medicine and to the Medical Research Council for whom the investigation into intestinal parasites was commenced in 1939.

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#### Congenital Dermal Sinus.- J. E. A. O'CONNELL, F.R.C.S.

Female, 4 years old. She was shown after excision of a congenital dermal sinus in the lumbar region associated with recurrent attacks of meningitis.

History.—When 8 months old the child was admitted to hospital with meningitis which responded to sulphanilamide. At the age of 18 months signs of meningitis recurred. Bilateral myringotomy produced no improvement and following admission to St. Bartholomew's Hospital a port-wine stain was found in the lumbosacral region with a small central pit from which sebaceous material could be expressed (fig.). The meningeal



Port-wine stain over congenital dermal sinus.

signs continued and the left leg was paralysed. Attempts at lumbar puncture produced a purulent fluid containing epithelial squames, polymorphonuclear leucocytes and coliform organisms. Cisternal puncture showed a turbid fluid containing the same organisms.

At operation the dermal sinus was traced through a defect in the neural arch of the fourth lumbar vertebra communicating with a large abscess within the dura and lying among the roots of the cauda equina. The track and part of the abscess wall were excised and drainage instituted. The wound healed after several months and now two and a half years later the child is asymptomatic.

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## Sulphæmoglobin(cyth)æmia and Anæmia Neonatorum.—A. WHITE FRANKLIN, M.B.

J. T., born 20.2.42, male.

First child. Forceps delivery at term resulted in a left facial palsy. Birth-weight 7 lb. 2 oz. Breathing was bubbly for two days but, on breast and bottle feeding, progress was normal until 27.2.42 when he vomited bright green curds during the night. Next morning skin was green and lips blue. Bowels were open normally on 25.2.42 but not again until on admission to hospital (28.2.42). At this time he looked ill, skin was of green hue, sclerotics not being discoloured, and lips and finger nails were a dark blue. Liver and spleen were not enlarged. No drugs had been given to mother or baby. Eight dark green stools were passed during the night and vomiting continued sporadically, sometimes bright green, but pigment not examined. Blood (1.3.42) appeared dark brown and on 2.3.42 sulphæmoglobin was found in a concentration of about 8%. It was intracorpuscular and Schumm's test on the plasma was negative. On 6.3.42 the skin was less green and the cyanosis was less, but mucous membranes were pale and by 10.3.42 he appeared markedly anæmic, the skin being tinged faintly green.

Urine contained much urobilin only. Stool cultures grew no abnormal bacteria. Serum bilirubin was increased on 6.3.42. Citrated blood transfusions (\*) were given

Differential films were normal throughout and at no time were nucleated red cells, seen. W.R. (23.3.42) negative.

In this case intracorpuscular sulphæmoglobin apparently developed spontaneously on the seventh day of life and was followed by an acute anæmia which responded to intravenous citrated blood. At no time was there clinical jaundice or enlargement of spleen or liver, nor was there ever erythroblastosis.

Postscript.—The baby failed to thrive, though neither anæmia nor sulphæmo-globinæmia recurred. Breast milk, high carbohydrate and high protein feeding were unsuccessful, maximum weight (12.3.42) being 6 lb. 5 oz. and the last weight (5.4.42) 5 lb. 10½ oz. Stools were frequent (seven to eight a day) but not watery and there was no dehydration. Death occurred at 7 weeks (23.4.42) Autopsy (Dr. Joan Ross) showed an emaciated infant with bronchopneumonia and multiple lung abscesses, and suppuration at sites of transfusions.

Bone-marrow showed normal erythro- and myelo-poiesis with a high proportion of megalokaryocytes. Liver and spleen contained masses of iron-containing pigment. Suprarenal and other endocrine glands were normal (pancreas not examined).

#### [April 25, 1942]

#### MEETING AT WINDSOR EMERGENCY HOSPITAL

#### Actinomycosis.—Charles Pinckney, F.R.C.P.

J. P., male, aged 12.

In September 1941 while evacuated to Wales noticed lump on left side of neck.

December 1, 1941: Came under observation. A cold abscess was observed over the middle third of the left sternomastoid.

December 5: Abscess incised. The pus smear showed streptothrix of the actinomycosis group with mycelia.

Given a course of M & B 693. Total dose 16 grm.

December 28: Potassium iodide commenced: dose gradually increased till a daily dose of 90 gr. was taken.

December 30: Further abscess over the lower third of the left sternomastoid muscle incised

January 9, 1942: Another small abscess below previous one incised.

April 7, 1942: Discharged. Scars of three abscesses firmly healed, no underlying induration. Still continuing with potassium iodide 90 gr. daily.

# Three Consecutive Cases of Pink Disease Cured with Parenteral Liver Therapy.—CHARLES PINCKNEY, F.R.C.P.

(1) C. D., female, aged 10 months.

Came under observation December 12, 1941. Birth-weight 7 lb. 4½ oz. Present weight 17 lb. 4 oz. Breast fed till 8 months, mixed diet since. When aged 8 months became very miserable; loss of appetite, hands and feet red and peeling.

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On examination.—Very miserable child with marked photophobia. Hands and feet "pink" and desquamating. Sweating over trunk with rash present. Tachycardia, Musculature flabby.

Given hepatex 1 c.c. twice weekly for 8 doses.

Discharged January 16. Weight 18 lb. 3 oz. Cheerful, no photophobia, no tachycardia, hands and feet normal colour.

(2) S. B., female, aged 9 months.

Came under observation December 18, 1941. Present weight 17 lb. 9 oz. Birth-weight 5 lb. 9 oz. Breast fed till December 4, mixed feeding since. When aged 8 months became miserable; lost appetite, hands and feet red.

On examination.—Very miserable child, photophobia, hands and feet "pink" and desquamating. Sweating over trunk and rash present. Tachycardia. Musculature flabby.

Treated at first with vitamin B by mouth with no improvement.

January 15, 1942: Given hepatex—I c.c. twice weekly for 8 doses as an out-patient. April 16, 1942: Weight 18 lb. 12 oz. Cheerful, no photophobia, skin dry and smooth, hands and feet normal colour.

(3) J. F., female, aged 12 months.

Came under observation April 1, 1942. Present weight 17 lb. 3 oz. Birth-weight 7 lb. 14 oz. Still being breast fed, but mixed feeding started as well, at 6 months.

When aged 11 months became miserable; lost appetite, goes to sleep head buried

in pillow, hands and feet red.

On examination.—Miserable child, photophobia present, hands and feet "pink" No rash. Tachycardia. Musculature flabby.

Given hepatex 1 c.c. twice weekly for 8 doses.

Discharged June 1, 1942, weight 19 lb. 1 oz., cheerful, no photophobia, no tachycardia, hands and feet normal colour.

Diabetes Insipidus Treated by Slowly Acting Pituitary Preparations.—Donald Court, M.B., M.R.C.P.

This boy was first presented to this Section in April 1939 (Court and Tayler). He

remains a case of idiopathic diabetes insipidus.

Now aged 7 years. Weight 45 lb. General health good. During a recent period in which all treatment was stopped, the daily fluid intake quickly reached 200 fluid ounces. For the past three years he has been treated with pituitary emulsion and, more recently, with pitressin tannate in oil. The former gave excellent control with ½ c.c. dose, twice weekly. It was abandoned owing to the delayed formation of paraffinomata at the injection sites. This unfortunate sequel is mainly due to the beeswax present in the emulsion. Also, through "Evacuation", only intermittent supervision was possible and it was subsequently found that the injections had been given subcutaneously instead of intramuscularly as instructed.

For the past six months pitressin tannate in oil (Parke Davis & Co.), 1 c.c. twice weekly, has been used with very satisfactory results (Greene and January, 1940). This appears to produce no local or general side effects. The control achieved with these preparations

is shown in the following table.

		No. of days	No. of	Hours per	Av. daily intake	Av. daily Output
Extract. Pit. Liq			injections	injection	Fl. oz.	Fl. oz.
0.25 c.c. and 0.5	C.C	14	28	12	64	65
Pituitary emulsio	n	24	8	72	61.5	49
Pitressin tannate	444	44	21	50	82 - 5	70.5

It is hoped to publish a more detailed account of slowly acting pituitary preparations in the near future.

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Hirschsprung's Disease. Treated by Spinal Anæsthesia.—Donald Court, M.B., M.R.C.P., and J. K. Hasler, M.B., D.A.

Male, aged 8. Healthy parents. First child. First seen 29.7.41. Constipated since birth. In the first two years would go four to five weeks without defæcation. Intermittent diarrhea also occurred during the first three years, but not since. Liquid paraffin regularly and intermittent enemata had been the mode of treatment prior to admission. This had produced fairly frequent small motions but had had little effect on the abdominal enlargement. He had become rather shy and anxious owing to comments about the size of his abdomen from his schoolfellows.

On examination.—Weight 48 lb. Sallow complexion. Distended, tympanitic abdomen with visible coils of large gut. Circumference at the umbilicus, about 30 in. Diagnosis

confirmed by straight radiograms and barium enema. Cystography also revealed a large bladder. Response to enemata unsatisfactory.

30.8.41 and 9.9.41: Spinal anæsthesia.

11.9.41: Normal bowel action began and continued until his discharge ten days later. 20.4.42: Now having one or two motions daily, much larger than ever before. Circumference of abdomen 23½ in. A further barium enema suggests a partial decrease in the

size of the bowel. The enema was spontaneously and fully expelled.

Details of treatment.—In accordance with accepted views on colon enervation, it was decided to give sufficient spinal anæsthetic to paralyse the anterior nerve roots, up to and including the 6th dorsal segment. As the patient was considerably younger than those to whom spinal anæsthetics are usually given, no guide to exact dosage was available. Premedication, nembutal gr. iii, was given. The patient was placed in the left lateral position and 1 c.c. of heavy percaine solution was injected after being mixed with an equal quantity of the patient's C.S.F. He was then turned on to his back and the head of the table was tilted slightly downwards. The patient was under continuous observation for an hour or more but very little visible peristalsis was seen and only a small amount of flatus was passed through a rectal tube. Priapism occurred and remained for several hours. The patient remained asleep throughout the proceedings but was "light" enough to react to a pin-prick above the level of anæsthesia. On examination he was found to be anæsthetic up to the intercostal space below the nipples. The posterior roots had therefore been paralysed up to the 5th dorsal segment. Under spinal anæsthesia the posterior roots are usually paralysed to about two segments higher than the anterior; we may therefore assume that in this case the anterior roots and their accompanying sympathetics had been paralysed up to the 7th segment.

Ten days later the procedure was repeated. This time 1·1 c.c. of heavy percaine was

Ten days later the procedure was repeated. This time 1·1 c.c. of heavy percaine was used with a slightly greater downward tilt of the table. Priapism again occurred and vigorous peristalsis was seen all over the abdomen. This continued for more than an hour but without defæcation. Anæsthesia was tested and the upper level was found at the intercostal space above the nipple, i.e. at the 3rd dorsal segment, therefore the sympa-

thetics were affected to the level of the 5th dorsal segment.

Comment.—The beneficial effects of spinal anæsthesia in cases of true Hirschsprung's disease, were first described by Stabins, Morton and Scott (1935). This has subsequently been confirmed by Telford and Simmons (1939) and others. The improvement in general health, bowel function and radiographic changes in the calibre of the bowel in this boy, are in keeping with previous results and very gratifying. Effective premedication meant that he was unaware of the procedures involved.

Two further points require emphasis—the level to which anæsthesia was necessary and the delayed but satisfactory restoration of adequate bowel function in the absence

of spontaneous defæcation during the anæsthetic.

We wish merely to record our findings, leaving the explanation of this remarkable effect until more facts are available.

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# Four Cases of Pulmonary Tuberculosis in Association with Meningitis.—NORAH SCHUSTER, M.R.

Four cases of tuberculous meningitis were all associated with pulmonary primary lesions and none of them showed any sign of ever having had an alimentary infection. The source of infection was clear in one instance only; in the others no tuberculous contact could be traced

The primary focus was in all cases in or near the apex of the lungs and not in the more

characteristic situation near the interlobar fissures.

Meningitis seemed, in 2 cases, to be a terminal event in hæmatogenous dissemination and in 2 cases to be due to breakdown of a pre-existing focus in the brain as described by Rich and others.

Case I was a girl of 7 years who had always been delicate and had measles a year before. The primary complex was indicated by a small caseous focus in the left upper lobe and a large caseous bronchopulmonary gland. The most striking feature was extensive infection of the pulmonary vessels, many of which, even of large size, were filled with caseous material teeming with tubercle bacilli. There was intense miliary dissemination and ample infection of the blood from the pulmonary vessels to cause diffuse meningitis without postulating antecedent foci in the central nervous system.

CASE II was a girl of 5 years with symmetrical healing foci in both apices, indicated by encapsulation and calcification. Near the left one there was a small crop of recent tubercles

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which had probably followed measles and whooping-cough three months before. There was no miliary spread and the only other tuberculous lesion was in the central nervous system. A tiny tubercle was demonstrated on the surface of the cerebral cortex and there was diffuse meningitis with caseation and partial organization. It is suggested that the latter was the result of rupture of a cerebral focus formed about the time of the primary complex, or at the time of exacerbation three months ago.

Case III was a boy of 7 months with a history of bronchial catarrh. The main feature was a fairly large cavity in the right apex with tuberculous bronchopneumonia surrounding it. There was hæmatogenous infection of the lungs, spleen and central nervous system. The presence of tiny recent tubercles in the meningeal arterioles, the large quantity and lack of organization in the exudate makes it probable that the meningitis was the final culmination of blood infection.

Case IV. A boy of 11, had small partially healed foci in both apices, numerous fibrohyaline tubercles on the pleura and enlarged caseous bronchopulmonary glands. The symptoms had been suggestive of cerebral tumour (3rd nerve palsy, &c.) and meningitis did not appear till the last days. It is highly probable that pre-existing foci were present

in the brain though they were not seen at the post-mortem.

There had been no opportunity of determining whether any of these children had shown signs of antecedent cerebral lesions to account for the meningitis, and it is suggested that it might be instructive to make special inquiries into the history of similar patients. It might also be interesting, in view of MacGregor and Green's observations, to examine the cerebrospinal fluid for tubercle bacilli of all children with tuberculosis before meningitis sets in, and of all children with any form of cerebral irritation.

Reference.-MACGREGOR, A. R., and GREEN, C. A. (1937), J. Path. and Bact., 45, 613.

### [May 22, 1942]

JOINT MEETING WITH THE MATERNITY AND CHILD WELFARE GROUP OF THE SOCIETY OF MEDICAL OFFICERS OF HEALTH

# DISCUSSION ON THE PREVENTION OF CHRONIC LUNG DISEASES IN CHILDHOOD

Dr. Alan Moncrieff proposed that by definition tuberculosis and asthma (primary allergic) be excluded from the discussion which should be limited to chronic and recurrent bronchitis, and the group called variously chronic pneumonia, pulmonary fibrosis, unresolved pneumonia, damaged lung-all tending to end in bronchiectasis. suggested certain general considerations concerned with infection and resistance. Under infection had to be considered that which came from outside (exogenous) and that which was present in the child's own respiratory tract. Environmental (exogenous) infection was essentially a public health problem. What was being done to reduce recurrent droplet infection in the home, in schools and in institutions? Was the public being sufficiently educated in the use of handkerchiefs and masks? Other problems in this group were those of ventilation, and sterilization of air by sprays and ultra-violet light (cf. shelter problems). Endogenous infection raised the whole question of chronic disease of the upper respiratory tract in childhood. Was anything being done to deal with "tonsils and adenoids" from the preventive aspect? Sinus infection was also of great importance and there was a large body of evidence that spilling over of pus from the nasal sinuses was responsible for recurrent and chronic lung infection.

Regarding the problem of resistance to infection, was there enough exact knowledge upon which action could be based? What was the exact relation between rickets and bronchitis? Was it a vitamin deficiency (A or D)? or due to carbohydrate excess with the production of a fat, flabby, "catarrhal" child? Was it possible to be more specific about the influence of nutrition in promoting resistance to disease? There appeared to

be a vicious circle—chronic infection →under-nutrition →chronic infection.

Acute lung infections which did not clear up properly or which recurred were frequently followed by chronic lung infections. Hence certain aspects of acute lung infection had to be considered. First came the occurrence of bronchitis and pneumonia associated with measles and pertussis. The problem seemed to be how to postpone these infectious diseases until after the age of infancy, possibly until after 5 years. Public health measures included the use of pertussis vaccines on a wide scale—in day nurseries and welfare clinics—and the use of blood (? blood banks) for modifying measles. Adequate convalescence after measles and pertussis was also very important. Secondly there was the problem of sulphapyridine in the treatment of pneumonia. Was there an increase in

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unresolved pneumonia since the introduction of this drug—especially since borderline cases of severe bronchopneumonia were now being kept alive? Was there anything to be done about this? Thirdly there was the question of collapse of lung. This was probably far commoner than was generally supposed and might be due to sticky sputum produced by the injudicious use of atropine and belladonna and too little fluid in acute lung conditions. Finally the speaker dealt with active measures in prevention of chronic lung diseases, from the clinical standpoint. Tuberculosis must be excluded actively because far too many cases of collapse of the lung were disastrously treated by the passive measures available for tuberculosis. Hence every case of chronic lung infection should have a tuberculin patch test, followed by X-ray examination, contrast bronchogram (iodized oil) and bronchoscopy in that order if the severer types of chronic lung disease were to be prevented. Other measures were investigation of sinus disease, the treatment of diseased tonsils and respiratory exercises after pneumonia.

Dr. C. Elaine Field: A small but important branch of chronic chest disease comprises collapse of the lung and its frequent sequela, bronchiectasis. Within the last two years at Great Ormond Street and University College Hospital I have seen 82 cases. Of these, 39 were of massive collapse only, and 43 showed bronchiectasis in addition, as proved by

bronchogram.

Ætiology.—Of the 39 cases of collapse, 31 cases gave a history of pneumonia or whooping cough and in 23 of these the onset of their symptoms could be directly attributed to one or other disease. In the 43 cases of bronchiectasis, 41 gave a history of whooping-cough or pneumonia, and in only two cases the onset of symptoms could not be attributed to either of these diseases. From these figures and others in the literature, it is justifiable to say that pneumonia and whooping-cough are the chief predisposing diseases of collapse

and bronchiectasis in children.

The theory of collapse.—It is well recognized that a plug of mucus will cause bronchial obstruction and massive collapse, but what happens for patchy collapse to occur: that is, blockage of the smaller bronchi and bronchioles? Lee Lander and Davidson suggest that the mucus plug gets sucked into the finer bronchioles. Fig. 1A shows a plug of mucus completely obstructing the left main bronchus. Collapse of the lung occurs distal to the plug. Increased negative intrapleural pressure resulting from the collapse produces a sucking action in the bronchi drawing the mucus into the finer bronchioles (fig. 1B and c). This procedure one imagines occurring in whooping-cough and some

cases of pneumonia.

Andras visualizes a different procedure occurring in pneumonia—a failure of absorption of the exudate. Fig. 2A represents diagrammatically a consolidated alveolus and bronchiole. Resolution occurs in the alveolus (fig. 2B) but not in the bronchiole. As a result air and exudate are absorbed (fig. 2c) with resultant collapse of the alveolus. Both these authors suggest that most cases of bronchiectasis are preceded by collapse. Now Hedblom proved that in cases of collapse of the lung there is an increased negative intrapleural pressure, on an average, twice the normal but it may be twenty times the normal. Fig. 2b represents a normal lung and fig. 2b the post-pneumonic condition. A consolidated plug remains in one of the bronchioles so that the alveoli supplied by that bronchiole collapse; the other bronchiole has become patent following complete resolution. The increased negative intrapleural pressure fails to expand the collapsed alveoli and the pull is therefore referred directly to the wall of the bronchiole causing it to dilate with each inspiration. This predisposes to stagnation of secretion and infection with weakening of the wall of the bronchiole and permanent dilatation. But the increased negative intrapleural pressure over the patent bronchiole causes emphysema, a common association with collapse.

#### PREVENTION

Pneumonia.—Sulphonamides when given in full dosage for an adequate length of time have, I think, resulted in fewer cases of unresolved pneumonia.

Whooping-cough.—In 1935 the L.C.C. Annual Report estimated that 44% of London children develop the disease before their 5th birthday. According to Maclean's figures from St. Mary's Clinic, 90% of these children could have been protected by vaccination.

Collapse of the lung.—If this be due to tenacious mucus, it seems inadvisable to give drugs such as belladonna which make the mucus more sticky and adherent; expectorants such as potassium iodide might be given a trial. In cases where collapse of the lung has occurred immediate bronchoscopy should be instituted and all mucus sucked out followed by daily breathing exercises. Of the 39 cases of collapse previously mentioned, 26 have cleared up; 14 of these cleared up within one month of bronchoscopic suction. If at the end of a week X-ray showed the collapse persisting, a second bronchoscopic suction was performed. Hart advocates repeating this as many as ten times. A certain

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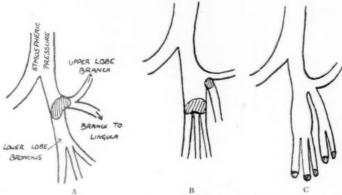


Fig. 1.—The mechanism of collapse. A opied by permission from "The Ætiology of Bronchiectasis," by F. P. Lee Lander and Maurice Davidson, Brit. J. Radiol. (1938), 11, 84.)

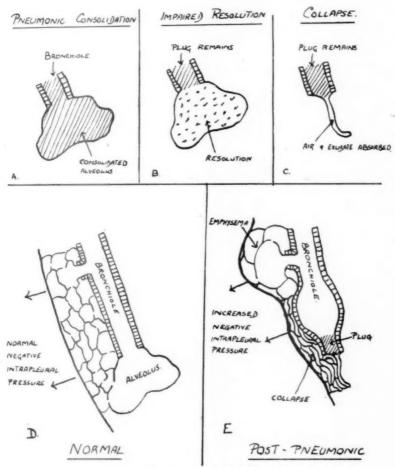


Fig. 2.—The mechanism of bronchiectasis.

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proportion of these cases will clear up without bronchoscopic suction, the child coughing up the mucus; but it seems inadvisable to wait for this to happen as time is vital. Erb reports a case of a child who died four and a half weeks after the onset of whooping-cough. At autopsy the smaller bronchi were plugged with a stagnant exudate and microscopy showed invasion of the plug with young fibroblasts from the connective tissue of the bronchial wall—possibly already too late for bronchoscopic suction to be successful. Further microscopic work shows that granulation tissue develops in the interstitial framework of the lung and invades the collapsed alveoli, so that expansion cannot occur even if the obstruction is removed. How long, therefore, after the onset of collapse can successful expansion be obtained? This probably depends on the length of interval before infection occurs, and the type of infection; the more virulent, the more rapid the onset of permanent changes. Massive or partial collapse should be treated as an acute emergency.

Bronchiectasis.—Little can be done to prevent bronchiectasis developing in a collapsed lobe that has failed to expand. Postural drainage, breathing exercises, fresh air and treatment for infected nasal sinuses may retard the progress and inevitable result. Artificial pneumothorax may stop advance of the disease but it is not curative. The relationship of sinusitis to lung infections remains a vexed problem. In 31 cases of collapse of the lung only four had clear antra in the X-ray, and in 34 cases of bronchiectasis only three had clear antra. Treatment of sinusitis helps to prevent the progress of the lung infection and improves the general health of the child.

Bronchiectasis can develop with incredible speed in a young infant in the presence of a virulent infection. Erb reports a case of acute dilatation developing within ten days of the onset of pneumonia.

Lobectomy should be performed when possible, to prevent spill over of secretions into healthy parts of the lung, thus causing further collapse and bronchiectasis.

I would like to thank Dr. W. J. Pearson and Dr. W. G. Wyllie and the staff of Great Ormond Street and University College Hospitals for their help and co-operation.

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**Dr. Nora I. Wattie:** In Glasgow 3-4% of school entrants show evidence of chronic lung disease. The prevention of these chronic and often recurring disabilities is dependant upon the possibility of controlling the original causative infection which is pneumonia either primary or as a complication of measles or whoming cough

monia, either primary or as a complication of measles or whooping-cough.

With regard to measles, placental globulin has been successfully used in institutions in Glasgow to produce attenuated attacks. It might be possible to extend its use to home contacts, particularly under two years.

With regard to whooping-cough, the modern vaccines in adequate dosage are definitely of value, both in producing immunity and in attenuating the severity of the attack when infection has taken place. The practical difficulty with regard to more widespread use of pertussis vaccine to produce immunity is that mortality and lung complications are highest in the infant, and to affect these the vaccine must be given as early as 3 months of age. The anti-diphtheria campaign has got the idea of prophylaxis at 1 year into the minds of mothers, and the change to an earlier age with more chance of some reaction in the infant may be difficult. Combined immunization against both diphtheria and whooping-cough at 9 months - 1 year should now be universally adopted. This combined immunization is insisted on as a condition of admission to war-time nurseries in Glasgow.

With regard to the pneumonias, the use of the sulphonamide preparation in adequate dosage has materially reduced the mortality rate and the number of cases with residual chronic infection. In the prevention of acute pneumonia in infants, however, education of the public on the dangers of droplet infection is important. Recent work carried out by Dr. Anderson of Knightswood Hospital, Glasgow, indicates that the type of pneumococcus present in pneumonia affecting infants under 1 year is that normally found in the upper respiratory tract. Housing and nutrition are also important aspects of the problem. Adequate provision of special convalescent facilities with skilled nursing is also urgently needed.

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# Section of Psychiatry

President-A. A. W. Petrie, M.D., F.R.C.P.

[June 9, 1942]

# DISCUSSION ON EFFECTS OF WAR-TIME INDUSTRIAL CONDITIONS ON MENTAL HEALTH

Dr. W. Blood: In the attempt to assess the state of the mental health of several thousand employees of both sexes working in large food factories, I have studied the figures relating to sickness absence for the years 1940 and 1941, the accident incidence for the same years, absenteeism, labour turnover and also everyday experience. The sickness records are based on the diagnosis as stated on the doctors' certificates and under the heading psychological causes are included nerves, nervous debility, neurosis, neurasthenia, anxiety, &c. Comparing the principal causes of sick absence in 1940 with 1941—the incidence of each illness being expressed as a percentage of the total illness—we get:

		1940						1941				
Respiratory info	ection	***	***	***		40%	Respiratory infection	***	440	400		41%
Gastritis	***					9.5%	Gastritis		***	***	***	7.9%
Works accident	ls			***	***	8.0%	Works accidents		***		***	10%
Rheumatism	***		***			6.7%	Rheumatism				***	8%
Tonsillitis				***	***	4.0%	Tonsillitis	411	***	***	***	2.7%
Daughalartigal						9.70/	Daughalastiant					9.10/

The particular points in these tables are that in 1940 2·7% of all sick leave was due to psychological illness, the comparable figure for 1941 was 2·1%. We are told, however, that a certain number of psychological illnesses masquerade under such labels as gastritis and rheumatism. The lost-time figure quoted is therefore almost certainly an understatement. The high figure in 1940 of 9·5% for gastritis has probably some psychological significance. The increase of works accidents in 1941, 10% as compared to 8% in 1940, has also possibly some psychological significance. It is not known how much, if any, of the gastritis (9·5% in 1940) and the rheumatism (8% in 1941) was really due to neurosis. With such knowledge one could judge the size of the problem much more clearly. If this problem is to be investigated it must be on cases of gastritis and rheumatism early, i.e. during the first two weeks of illness—if the results are to be valuable to industry—for this is the approximate duration of the vast majority of illnesses due to these complaints.

From my 1941	records 1	find	the	ratio of	male	and	female	sick	abs	ence	from	М.	F.
all causes t		***	***	***	***		***	***	***	***	***	1	1.7
From frank ps	vchological	cau	ses	41.1	***	***		000				1	4.0
From gastritis	***				***	***		***		***		1	1.2
From rheumatism	13			***							***	1	0.56

There is room for speculation here since if much psychological illness was masquerading under rheumatism and gastritis, one might reasonably expect the female part of the male-female ratio for these complaints to be higher.

In September 1940, when the blitz on London was at its height, from a group of factories employing over 2,000 men and women, only 22 were away ill with nerves, &c. Besides loss of time due to psychological illness, both obvious and obscure, to what extent is absenteeism from unknown causes due to mental ill-health, maladjustment or fatigue? I am sure from my own experience and from hearing the experiences of many other factory doctors that a fair proportion of absenteeism, otherwise unexplained, is due to mental ill-health (in its widest sense) or fatigue, and many cases could be quoted in support of this statement. When one considers the causes of extra strain thrown on the working population during the past two years, for example, the war, bombing, worry over relatives, children evacuated, the black-out, food difficulties, long hours, overtime and often a completely changed life as when a clerical worker or housewife goes into the factory to work, it seems obvious that some absenteeism must be due to mental ill-health or maladjustment or fatigue, often not recognized as such by the absentee. With appropriate organization in the factory, much can be done to smooth out individual psychological difficulties before they lead to sickness and absenteeism.

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Accidents.—My figures for 1941 show an increase of 50 notifiable accidents over 1940. This increase of accidents is. I believe, common to industry. Much of the increase is due to inexperienced newcomers to industry—people who have not acquired the factory outlook nor the dexterity that is essential for some jobs. Furthermore the age of the factory entrant to-day is much in advance of that of the usual peace-time entrant, and these middle-aged people are harder to train. There is, however, reason to believe that some of the noted increase in accidents is due to maladjustment or fatigue, causing inattention or lack of co-ordination. One of the chief worries of the factory doctor is to see a man or woman, whom he knows to be fundamentally decent, failing by reason of the development of psychological symptoms to get back to work, after their accidental Sometimes we are forced to witness psychological injury has completely recovered. symptoms getting worse, although the patients are still attending hospital for their injuries. I should like to see a medical psychologist attached to every injury clinic, so that patients could be brought under psychological review at the earliest possible moment and those in need of treatment given it immediately -instead, too frequently we find the trouble getting steadily worse and nobody bothers-it is nobody's business.

Mental ill-health, fatigue and maladjustment, as the cause of excessive labour turnover, inefficiency and unhappiness.—Before the introduction of the "essential work order" it was common experience that large numbers of workers were continually leaving one job to go to another-often so far as one could tell without good reason. Were they all seeking more pay, shorter hours, better conditions? I think not. Some I believe were fatigued, and others suffered from nervous strain—this expressed itself as a "fed-upness" an irritability and a desire for any kind of change. Much waste of time and loss of production was caused by this flitting from job to job.

What is the position to-day?-Most foremen and managers say that some of the workers are rather more "touchy" than they were pre-war. My own impression is that I meet more people who are tired and dissatisfied with their work. There are some who object to having their jobs changed, others who are always wanting a change and others who complain without just cause. There are to-day, I believe, a certain number of people (more than in pre-war days) suffering from a below-par mental state which is manifesting itself as a restlessness in some, an irritability or unhappiness or truculence in others, and if one recognizes the existence of this below-par state, many of the difficulties can be successfully dealt with. The doctor, the manager or the foreman must listen patiently to the workers' difficulties and grievances, real or imaginary. When they are real, help must be given, when they are imaginary, patient listening often effects the cure. There is need in industry to-day, as always, for patience, politeness and common sense. Sometimes it happens that a workman (or girl) who is sent to the doctor because he or she is "difficult", is physically ill. I can remember cases of tuberculosis, gastric and duodenal ulcers, who were first brought to notice by their difficult behaviour. To realize fully the effects of mental ill-health in industry, one must remember (a) the lost time due to frank psychological illness and absenteeism from underlying psychological causes, (b) the relation of mental ill-health and fatigue to accidents, both to the causation and to the prolongation of incapacity, (c) the prolongation of physical illness due to associated psychological factors, and finally (d) the inefficiency and waste of effort in having "a square peg in a round hole". Sometimes the cause or aggravation of mental ill-health lies in the works, where this is so it can be dealt with satisfactorily by a reasonable management. I allude to excessive hours, excessive overtime, under-pay, inequalities of pay for similar jobs, excessive night work, unhealthy or dangerous conditions of work and bad supervision. More often, however, mental ill-health emanates from sources outside of industry but many cases can be adjusted satisfactorily within

What can be done to maintain mental health in the factory.-It is essential that wages, hours of work, security and conditions generally be satisfactory, and conform to the proved economic and physiological needs of the worker. If these "bread and butter' needs are satisfied I attach the greatest possible importance to (1) harmonious relationships within the works, and the full recognition of the worker as an individual, (2) to the development of the social group within departments, and affiliation to larger groups within the organization. In my own works we have been slowly evolving an organization, parts of which are still experimental, but which we hope will counteract some of the psychological difficulties previously experienced, and prevent others from developing. The organization consists of four main parts: (1) The staff record or engaging office; (2) the medical department; (3) welfare department; (4) the club. The applicant for employment is received courteously and particulars of his industrial experience, personal particulars, &c. are quickly

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taken. He is then told about the job, the hours he will work, the wages he will receive and the holidays that he will be entitled to. He is then conducted to the medical department where he is examined to ascertain whether he is fit for the job (if not fit, the doctor offers suggestions for alternative work). The next move is to the welfare officer who informs him of the various welfare schemes, sports clubs, &c., also what is expected of him, e.g. punctuality, regularity, cleanliness and observance of the firm's rules. He is then told of what the firm will do for him in the way of sick pay, and various privileges, and it is impressed on him that if at some future date he has any kind of grievance he can see the welfare officer at any time, and if need be a director of the firm.

The applicant is then conducted to his department, and introduced to the superintendent or foreman and shown the job. Where training is necessary suitable arrangements are made. Before starting work the newcomer is introduced to one of the workers who shows the novice the ropes of his department and the cloakroom, canteens, lavatories, &c. Foremen and forewomen have special instructions to keep a friendly eye on the newcomer for the first week or two.

The follow-up.—During the first week or two the newcomer receives two or three visits from the welfare officer who originally interviewed him. This officer inquires how he is getting on with the job, &c., and also speaks to the foreman to get his opinion of the employee. Sometimes at this early stage it is obvious that the worker has been wrongly placed and transfers are arranged. I attach considerable importance to the follow-up, as a means of assisting the newcomer to find his feet; it also gives him a feeling that the firm is interested in his well-being. So much for the newcomer, but what of his future The welfare department, in close co-operation with the medical department, is responsible for the mental and physical health of the staff. Some of the methods adopted are: (a) Educational, lectures and discussions, in particular to superintendents and foremen and forewomen on such subjects as the Human Factor, Factory Hygiene, Accident Prevention and on the care of staff, with emphasis on the correct attitude to be adopted by supervision in dealing with staff problems; (b) music is relayed to most of our factories for periods of half an hour several times a day. Its value in allaying monotony is unquestionable, providing suitable music is chosen; (c) other duties of the welfare department are to give advice and assistance on any difficulties connected with work, financial troubles, home worries, love affairs, day nurseries, hospital savings associations, income tax, and, in conjunction with the medical department, convalescence, special diets and consultations with specialists are arranged where necessary, in full co-operation with the family doctor. There is no doubt that a well-run welfare department can assist in maintaining the mental health of the staff by relieving them (by advice and financial assistance when necessary) of troubles which, without help, might prove overpowering. Ultra-violet light in tonic doses has proved of considerable value in keeping night workers fit and cheerful.

Sports clubs and social activities play a large part in maintaining physical and mental health. They give opportunity for games in the fresh air, and for the formation of lasting friendships. In my own firm there are two full-time social organizers who arrange social functions, entertainments, sports and interdepartmental competitions.

Dr. Joan Harwood: I have been working in a factory in an area of Britain which is not purely industrial, and which for the first year of the war was not materially affected by the very great changes in industrial conditions which occurred in some parts of the country. Since then our staff in the factory has changed considerably: many have left, and some have been replaced by older workers on both the men's and the women's side. Anything like accurate analysis of sickness due to mental conditions is impossible.

At first thought, one might expect a large increase in the number of cases of mental disturbance, but this is offset by the fact that the war effort has provided large numbers of bored people with an interest, lonely people with companionship, and has relieved the economic anxieties of some, although it has increased those of others. Workers of the older generation particularly have been given an increased sense of personal value, and absorption in work gives people of all ages relief from the depression and tension resulting from separation from those they love.

The main factors which have a bearing on the mental health of the industrial worker are fatigue—in which I include boredom—anxiety and depression, and these are likely to be increased in war time. The effect of these naturally varies with the degree of exposure, and the particular chink in the individual's mental armour, and they would seem to be the chief exciting causes of conditions which appear on medical certificates as nervous debility, nervous exhaustion, nervous dyspepsia, and those two discussion-producing diagnoses, neurosis and neurasthenia. If we can do anything to mitigate these three elements in industry we shall have gone a long way towards forestalling trouble.

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In the early part of the war, inadequate or hastily improvised methods of black-out were a source of depression. In some factories many windows were permanently blacked-out or bricked-up. The result was that, in the daytime, parts of the factory were gloomy, or at the best, people were working in artificial light all day. With improvement in methods of black-out and ventilation, at least one cause of depression was removed. Poor canteen and cloakroom arrangements, and dingy surroundings, have a similar effect. Women are depressed if they have to wear unsightly-clothing, and this should be taken into account when protective clothing has to be provided. If they do not like the clothing, they will either refuse to wear it, or they will grumble and wear it in such a way that its purpose is defeated. Incidentally, it is probable that the morale of many women who have been out of work for years will be improved by the wearing of essential new clothes which they can now afford, being in a job. This will be more noticeable where the labour is drawn from what used to be known as distressed areas.

There are many factors which cause extra fatigue in war-time, and of these, long working hours and lack of sleep owing to air raids or alerts, are the most obvious. Long spells of night work are not tolerated well by women. In married women, or single ones with dependants, this is probably in great measure due to the home factor, which causes additional strain. There is a tendency to do too much housework, especially in the daytime after working a night shift. The inclination to worry about those at home, either children or elderly relatives, is increased during night work, especially when raids do occur.

Young girls, just starting on night and shift work, are bad offenders in the matter of sleep, as they quite understandably find it hard to give up frequent visits to the pictures and dance halls—in a way they are perhaps paying the price for the present-day standard of values, which has tended to make people more incapable of amusing themselves in creative recreation instead of passive entertainment. Incidentally, of course, women do not finish growth until they are about 23 years old, and are therefore up to that age least suitable for night work.

Dyspepsia is a common trouble on night and shift work, in both men and women. This is most noticeable in the maladjusted worker, when it may become a conscious or unconscious means of escape from having to do night work or shifts. Advice on the arrangements of the home routine may help the more normal worker. Single girls living alone often do not have time to shop for adequate or suitable food. They then become dyspeptic, run down or anæmic, and tire easily.

Bad transport unfortunately still exists in many places, and is exasperating to the tired

worker at the end of a heavy day or shift.

Repetitive work demanding skill and concentrated intelligent attention is fatiguing. A works manager of an aircraft factory told me that they had found that girls doing concentrated precision work at machines did it extremely well, and thoroughly enjoyed the work, but that at the end of a shift they were often in a state of tension. They were irritable and nervy, and quarrelled easily. Some burst into tears on the slightest provocation. The necessity for relaxation is obvious, particularly before the worker has a heavy meal. A drink immediately after work is helpful, and rhythmic exercise, such as walking or cycling home, acts as a sedative. I believe that if facilities for games, or keep-fit exercises, could be provided at factories or factory hostels, they would be of value. In arranging for the types of exercises to be used in such classes, the kind of work which is done in various parts of the factory should be borne in mind. For instance, monotonous and easy kinds of repetitive work might be relieved by vigorous exercises, but after work like the above the emphasis should be on relaxation. Slow rhythmic exercises, such as are found in Greek dancing, would be restful for these workers, especially if done to music.

Careful selection and placing of workers, from a medical as well as a psychological point of view, will cut down fatigue. A works doctor has an excellent opportunity of assessing the working value of an applicant at the initial examination. It is clear from the employment and medical history, the physique and mental attitude of the applicant, whether he or she is likely to show a record of bad timekeeping, or will not stand up to a job involving any particular strain. In workers of borderline physique, it may be advisable to consult the labour officer or manager; or get details of the medical history

from the panel doctor in the case of an unwillingly conscripted worker.

In the factory with which I have been associated we have a psychologist, and tests have been designed to assess the aptitude of workers for various jobs. These tests follow the lines usually adopted by industrial psychologists. Sense of form, co-ordination, rhythm, mechanical aptitude, various types of memory, and other faculties can be measured, and the worker placed accordingly. The worker who will be most happy on simple repetitive work can be separated from those capable of, and requiring, more interesting work. The

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clumsy worker, for instance, will not be tormented by having to do fine work requiring precise movements.

Even more essential is care in the choosing of executives. The petty tyrant with a lust for power, and the executive who shirks responsibility or lacks discipline, will obviously be a disruptive influence in the workroom. The one may at any time become entirely ruthless, and the other will lose the confidence and control of the workers. The ideal person is one who can lead without driving. In an old-established works the most satisfactory way is probably to choose from amongst known workers, using the psychological or some standard performance test as a balance.

Co-operation between the works doctor and personnel or welfare workers can be a vital link in dealing with people who are mentally upset or disturbed. The personnel worker is in a position to give the doctor valuable information concerning the worker, and can carry out suggestions for dealing with difficulties. Frequently their knowledge of individuals will help the doctor in handling the patient.

The menopausal woman, who constitutes quite a high proportion of the present industrial population, does at times present a difficult psychological problem. Often the executive woman has reached ripe experience when she is most valuable at her work, but she is less resilient than she was, and sometimes needs intervals for rest between spells of her work. In these days she often receives less tolerance and understanding from her colleagues than she should, at a time when she is often feeling that she is becoming a less charming and effective member of society. The average woman responds well to encouragement, and this, coupled with suitable treatment, will go a long way towards helping these cases.

Of the many minor, but nevertheless very potent, fears likely to arise in some factories in war-time, demotion or loss of job owing to the cutting down of work or re-organization is common. Older women as a rule dislike change of work, and anything which can be thought of to temper the wind will be of value. Younger ones mind this less, especially if they can be moved in a group with their friends; but they usually dislike being sent to work far away from their home towns, and illness is frequently a synonym for homesickness in girls with a small supply of backbone.

It has been suggested by some people that women will probably dislike work which produces destructive material. I do not think that the average young girl pictures the end-result of destruction, but the older worker, especially the older executive, often does. Curiously enough, working men very often dislike their womenfolk doing this type of work for this reason, but the sober necessity is philosophically realized by both.

Fear of danger is seldom present in the young worker, but parents are often afraid for them, and will try to prevent them going in for dangerous work. They sometimes succeed in instilling fear, in young girls especially, where it did not previously exist. The older worker, again from experience, has a more lively imagination and this is an advantage or disadvantage according to temperament. Thorough education and drilling in safety arrangements produce confidence, and morale is then high. This is well illustrated in the Royal Air Force. Higher pay for dangerous work is a help. People are more willing to bother with the necessity for taking precautions, if there is an additional financial incentive to do so. This is not merely a question of avarice: the higher rate of pay is a demonstration of the value and responsibility of the work performed, and raises the prestige of the worker both in the workroom and at home. This has also been proved in connexion with a type of war work which has a high dermatitis risk, and which requires almost niggling standards of cleanliness and care of the skin, if the workers are to be kept free from rash. Propaganda is essential, and the workers should be made to realize that their problem is the management's. Good pictorial posters with the minimum of reading matter are better than long notices. Meetings of workers' representatives, managerial staff, and the works' doctors, are helpful in spreading proper information and dispelling false rumours, and in securing the co-operation of the workers which is so

Fear of any occupational disease can become a difficult labour problem if it is not handled well. Good facilities for rehabilitation of the sick or injured worker go far towards alleviating anxiety in industry, so that this too will play an important part in the fight against occupational risks.

Dr. H. M. Vernon (in absentia read by P. E. Vernon): In the last war the sickness and loss of efficiency experienced by munition workers was so considerable that Mr. Lloyd George, the Minister of Munitions, appointed a "Health of Munition Workers Committee" to investigate it. The Committee was appointed in September 1915, and it sat till the end of 1917. Special attention was paid to the health of the women, as they were much more adversely affected than the men. A total of

about 1,300 women working in eleven factories was examined during the first half of 1916, and a second set of similar size in the autumn of 1917. They were classified as regards health into three main groups, and it appeared that 58% of them were healthy, whilst 35% showed some signs of fatigue or ill-health, and 7% showed marked fatigue or ill-health. Many other women had dropped out altogether because of ill-health, and in consequence escaped examination. The most frequent defects noted in the women were probably of mental origin, for it was found that, on the average: 28.5% had frequent neadaches; 20% were tired, nervous, or irritable; 23.5% had indigestion; 26% had disorders of menstruation; 20% had anæmia; 12.5% had rheumatism or muscular pains. No doubt many if not the majority of cases of indigestion were psychoneurotic in origin,

and this may apply also to at least some of the menstrual and other disorders.

The fatigue of the women was shown indirectly by their accident rate. At a fuse factory of 10,000 workers I observed that the accidents treated at the ambulance room were nearly three times more numerous when a twelve-hour day was being worked than when a change over to a ten-hour day was made. During the twelve-hour day period some work was done on most Sundays, and the total hours came to about seventy-four per week, as compared with the sixty-three to fifty-five hours subsequently worked. The majority of the accidents were cuts to fingers and thumbs, but other types of accident such as muscular strains were equally affected by hours of work. The workers sometimes went to the ambulance room for a rest, and I found that in the twelve-hour period the women were treated for faintness nine times more frequently than the men, whilst they were given sal volatile as a restorative twenty-three times more frequently. When the hours of work were reduced to ten a day these cases greatly diminished, and the women were then

treated only about three times more often than the men.

Observations made on the health of male munition workers during the last war showed very little evidence of mental effects. About 1,500 men, aged 41 and upwards, and 1,500 boys, aged 14 to 17, were medically examined, and of the men 17% were considered to be slightly below normal, whilst 5% were much below normal and 0.4% were in a bad state of health. The boys were much healthier than the men, the corresponding figures being 8% below normal, 0.9% much below, and 0.2% in bad health. These figures may to some extent reflect age differences, but it is likely that they also show the effects of working hours; for about 40% of the men, as contrasted with 2% of the boys were working over seventy hours a week. The men lost, on an average, eight days a year from sickness and accident, and the boys five days, but only 0.4 day of the men's time and 0.3 day of the boys' time were attributed to "nervous" causes. No doubt this apparent infrequency of mental ill-health was due largely to the neglect or ignorance of this aspect of industrial health which was usual at that time, but nevertheless it is in striking contrast to the observations made on women. The men were obviously much less fatigued by long hours of work than the women, and in the fuse factory investigation I found that their accidents during the twelve-hour day period were only slightly in excess of those incurred during the ten-hour day,

A somewhat similar difference between men and women has been observed during the present war. In Emergency Report No. 2 of the Industrial Health Research Board we are given some striking evidence of the effects on health of the strenuous production drive which occurred in munition factories immediately after the withdrawal of our troops from Dunkirk. At one factory, where the hours of work during June to August 1940 were from sixty-seven and a half to sixty and a half, the number of women absent because of nervous breakdowns and nervous debility increased from 11 per thousand per week during June to 18 per thousand in July and 23 per thousand in August. Hours of work were then reduced to fifty-seven a week, and the nervous cases fell at once to 14 per thousand and subsequently to 8 per thousand. During June to August the nervous cases were almost as numerous as those due to all other causes such as colds, influenza, gastric affections, and rheumatism. In contrast, at a factory where men were employed the nervous cases were only a fourth as numerous as those due to other causes, and in the months of June, July, and August, when the hours of work were seventy-one to sixty-six a week, they numbered only 4, 7 and 6 per thousand respectively. Subsequently

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# Section of Dermatology

President-H. C. SEMON, M.D.

[March 19, 1942]

# Clinical Photography in Private Practice

By A. C. Roxburgh, M.D., F.R.C.P.

There are various ways of taking clinical photographs in black and white. Either daylight, electric light (photoflood) or flashlight (photoflash bulb or flash powder) may be used, with either a half-plate camera, making contact prints, or a miniature camera, making enlargements up to half plate. Half-plate size is the most generally convenient size for the prints in either case. I always use a miniature camera and enlarge, the advantages being small size of apparatus, great depth of focus, allowing use of larger stop and therefore shorter exposure, and cheapness of materials. An even greater advantage perhaps is that it is easy to improve the composition of the picture when enlarging and also to darken or lighten parts which require correction by extra exposure or shading.

My difficulty is that I have no separate room available which can be kept always rigged. The apparatus must therefore be of the smallest and simplest so that it can be got out, arranged and the photograph taken during a half-hour consultation without delaying the next patient more than ten to fifteen minutes. As Twiston Davies has emphasized the only time to photograph an interesting patient is the first time one sees him, as a later appointment may not be kept or the condition may have changed.

Essential points are:

Lighting.—This should be arranged to show up raised lesions and skin texture in maximum relief, i.e. oblique lighting, not too diffused. Usually the beam of light should make an angle of about 45 degrees above and 45 degrees to one side of the line from patient to camera. A white towel hung on the shadow side of the patient just out of the field of view helps to reflect light into the shadows. I use either a photoflash bulb (Baby Sashalite) fired by dry battery or a photoflood lamp in reflector held in the hand and moved about until one is satisfied that the illumination and relief are as good as possible. If I am going to use a photoflash bulb I use an ordinary portable reading lamp first to find the best position for the light and then hold the flash in that position when taking the photograph. The light is usually held 2 to 3 ft. away from the patient.

Background and composition.—A plain background should be used. I use a plain bluish cloth screen over which I hang a dark blue rug if a darker background is required. All extraneous objects and bits of clothing should be carefully eliminated after study of the picture in the finder. This is not the place for a dissertation on the elements of pictorial composition but, although a record and not a picture is aimed at, good composition will make the photograph easier to look at and therefore more useful. An important point is that even in the case of a close-up view of a lesion enough of the patient should be included to make it obvious what part of the body is represented. In the case of extensive eruptions two photographs, one to show distribution and the other details of the lesion, should be taken.

Type of camera.—I use a Rolleiflex twin lens reflex taking a picture 2 by 2 in. If working at short range one must remember to allow for parallax, i.e. the finder lens is 11/2 in. above the taking lens. This camera allows of easy and accurate focusing and composition on a ground glass screen. One should always use a cable release for the shutter so as not to shake the camera and to allow of release while watching the patient. A lens hood should be used to keep glare out of the lens. "Proxar" supplementary lenses are slipped on for close work.

Film.—Orthochromatic film should be used, not panchromatic. The latter makes a red eruption look as light in colour as normal skin and therefore it hardly shows at all. If only panchromatic film is available a blue filter should be used. I now use Selochrome or Verichrome film, size 120. This gives twelve pictures 2 by 2 in. to each spool

Exposure.—Using a Baby Sashalite flash bulb the stop required is from f/4.5 to f/8 according to depth of focus required and distance of light from patient. With a photoflood lamp generally about half a second at f/5.6 is correct.

Arrangement.—The camera rests on my desk, if necessary being raised on books. There is thus no risk of kicking away tripod legs. Hands to be photographed rest on desk on a piece of black velvet which is carried back over patient's chest, and head and shoulders if necessary, to block out extraneous objects. Legs and feet are photographed on a couch brought up near the desk. The face is taken by sitting the patient on a low stool near the desk. The trunk is taken with the patient on a chair near the desk.

Method of taking .- (1) Arrange patient and lighting and focus accurately. Select stop.

Using Photoflood

(2) Set shutter to { second exposure.
 (3) Leave room lighting on so long as none shines into the lens.
 (4) Hold light in best position with one hand.
 (5) Release shutter with other hand.

Using Flashlamp
(2) Set shutter to "bulb" exposure.
(3) Turn down main room lighting and leave only dim light in room.
(4) Open lens with one hand, i.e. press release (5) Set off flash with other hand.
(5a) Close lens, i.e. let go release.

(6) Change film.
(7) Repeat with slight variation of stop or lighting.
(8) Record name, age, and diseases of patient. Date, stop and exposure.

\*\*Detectopment.—I use a fine grain developer, usually one containing "Meritol", and enlarge to half plate on glossy, contrasty paper such as Kodak Nikko.

[A number of photographs of various skin diseases, taken by the methods described, were then projected in the contraction of the con

As a matter of interest I am now going to show some colour photographs taken by Mr. F. G. Hennell by a new process of his own devising which produces colour prints of any required size, larger or smaller than the original and in any required number, but which are opaque and can only be projected by an epidiascope. These photographs are taken by flashlight in a one-shot, three-plate camera, and the colour separation negatives so produced are printed on to three stripping films. These films are separately toned by metallic salts and then squeezed down in register on any suitable paper, card or other base. Though none of these deals with dermatological subjects they do show the admirable results which can be obtained,

Discussion.—Dr. F. A. E. SILCOCK described and showed coloured photographs, sections and coloured photomicrographs of (1) Fox-Fordyce syndrome in a woman aged 29 (2) erythema elevatum diutinum on backs of both hands and wrist in a woman aged 30 years. Owing to present difficulties of bringing cases from a distance to this meeting he thought this method of demonstration might be very useful and convenient.

Dr. TWISTON DAVIES: How did Dr. Silcock take his colour photomicrographs and estimate the exposure required?

Dr. Silcock: The section is placed and focused under the microscope in the ordinary way, then the microscope with the slide in position is tilted into the horizontal position and the reflector adjusted to give good illumination. The miniature camera, a Zeiss Ikon, is brought up to the ocular of the microscope in the same horizontal plane till Ikon, is brought up to the ocular of the microscope in the same horizontal plane till it just touches it firmly. All extraneous light is excluded by means of some suitable covering, e.g. a piece of dark cloth wrapped round the junction. Film used was Kodachrome A (for artificial light), One photoflood light was used and reflected as described above. The camera lens was set for infinity, the aperture used was f/3-5 and the exposure was one-fifth of a second. One-tenth of a second was also tried, under the same conditions, but was not sufficient. I hope to make further trials of this simple method of taking soleaned abstractions as it does not require any energy. method of taking coloured photomicrographs, as it does not require any special apparatus.

#### [May 21, 1942]

### Industrial Dermatitis

### By SIBYL HORNER, M.B., D.P.H.

Although dermatitis in industry is not notifiable, the number of cases voluntarily reported to the Factory Department (now of the Ministry of Labour and National Service) has increased from 2,000 cases in 1938 to nearly 5,000 in 1940.

Dermatitis and ulceration of the skin produced by dust or liquids are conditions compensatable (by certificate from the Examining Surgeon) under the Workmen's Compensation Act. The number of such cases was 2,735 in 1938 and 6,196 in 1940. In the U.S.A. it is estimated that 65% of occupational diseases are industrial dermatoses. In one year 20,000 men lost an average of ten weeks' work through this cause. Preventive work in this country has made important advances of late years, but much remains to be done in the way of effective supervision in the factory. Dermatologists are, however, mainly concerned with recognition and treatment of industrial dermatitis.

Specialist treatment will in many cases reduce the period of absence from work and may possibly diminish the risk of recurrence.

Workers have, it should be remembered, a lurking fear that dermatitis is due to dirt and that it is contagious. The result is the free use of soap and water and antiseptics even when instructed to the contrary. This will delay a cure.

Recognition of industrial dermatitis lies in the clinical eye, in the wideness and accuracy of differential diagnosis, and especially in an accurate working history from the sufferer. If the cause does not appear to be occupational, household or avocational causes should be considered. The patient should be asked to give his own opinion as to its origin, or to demonstrate his movements at work. Friction, either of itself, or combined with an irritant is sometimes the clue.

The common causes of industrial dermatitis at the present time are oil chemicals (including explosives), alkalies, solvents or degreasing agents. Cleansers, often alkaline or degreasing in character, are sometimes responsible for more dermatitis than the industrial materials handled. Dusts, sprays and vapours usually affect the face, exposed neck and flexures of the body before affecting the hands. Oil folliculitis is commonest on the forearms but by permeating through aprons, may produce a rash on the thighs. The hands are rarely affected and sore fingers in a machinist suggest friction in a bath of alkaline coolant. Some chemicals stain the skin, others cause excessive dryness and characteristic lesions on a broken surface, e.g. salt "holes", ulcers from bichromates and formaldehyde. Dermatitis frequently follows an injury (which may have become septic) or a burn.

Prevention of industrial dermatitis: Briefly the protective measures are: Selection, protection, inspection and cleanliness.

Selection: Choice of suitable personnel, to whom is explained the procedure of

Protection: In addition to efficient ventilation, splash guards and protective clothing, the exposed skin must be protected by a "barrier substance". A good barrier substance must be non-irritating and easily applied. It must be insoluble in the substance from which skin protection is required, and it should be easily removed after work. Where there is a danger of absorption through the skin, e.g. T.N.T., or aniline, barrier substances containing no fats should be used. No protection is complete without good facilities for washing with supervision to ensure the best use of these.

The use in industry of chlorinated naphthalene waxes produces a characteristic skin eruption, a non-infective folliculitis. This is well marked on the forearms in early cases, but is most typical on the face where it affects mainly the malar and mental regions. Pustulation may be present in late cases and occasionally there are general symptoms of malaise and depression with digestive disturbances. The skin affection seems to be due to the actual deposition on the skin of vapour from the heated wax rather than to internal absorption and subsequent excretion. In addition to this recognized wax rash, exposure to fumes during the heating of chlorinated naphthalene waxes has been followed by a few cases of serious liver damage some of which have had a fatal result.

The skin reaction to chromic acid and to the bichromates may not be the typical "chrome

ulceration" (which is notifiable), but dermatitis, indistinguishable from that of other irritants. Recently a number of such cases has occurred in anodizing, where only a weak solution of chromic acid is used by an electrolytic method. Here the two factors for resultant damage to the skin were present, i.e. trauma from unjigging articles coming from the acid bath, and contact with the residual irritant, leaking through faulty washers. Instead of "chrome ulceration" dermatitis was the result. This is worth bearing in mind where weak solutions of chromic acid or bichromates are encountered and there are opportunities for superficial damage to the skin.

A topical source of irritation of the skin and mucous membranes, by bichromates, probably intensified by ammonia, occurs at "chromating" baths, which are non-electrolytic but are heated to a high temperature with evolution of fumes which must be removed from workrooms if damage to personnel is to be avoided. The most common result at these baths is ulceration and perforation of the nasal septum, and the latter may occur after only a few weeks' exposure.

The effects, i.e. trophic changes preceded by cracking and dryness of the skin of the last phalanges of the fingers of beta radiation from the radioactive substances in the luminous compound used for painting dials and instruments should be looked for, as if this condition is detected in a luminizer there may be still sufficient time to prevent the more serious effects of gamma radiation. The typical skin changes, due to beta radiation, will not be confused with the drying effect of certain solvents used in luminizing paints.

There are several types of glue at present in use for aircraft. Some of these are acid in reaction while others are alkaline. Added hardeners for certain glues include alkalies and acids. All types of glue have been known to cause dermatitis, and the element of friction of the forearms with glue-contaminated benches and aprons is, I believe, a common factor for the production of the trauma which so often precedes dermatitis. It is, however, of the greatest importance that glue should not be allowed to harden on the skin. With the use of animal glues warts were not uncommon; again trauma, with the possibilities of infection is an ætiological factor,

Industrial methylated spirit is being supplanted to some extent by the use of methanol, methyl alcohol. The latter may be found to have an even more drying effect on the skin.

Hexamethylene tetramine, urotropine, which we have respected in small quantities as an accelerator in the rubber industry, may now have to be reckoned with in larger amounts in its newer uses.

Recently observed effects were considerable thickening and cracking of the skin with some loss of sensation in the finger tips. These changes were noticed chiefly on the palms of the hands where there was discoloration (tanning) of the skin. It is interesting to note that among a group of workers, a high percentage of whom showed some or all of these changes, it was the loss of sensation in the finger tips of which they complained. After the protective measures had been instituted good results were reported, with some relief from this distressing affection. Dermatologists can assist in the prevention of industrial dermatitis by teaching preventive methods both to their students and their industrial patients while their contribution to the national effort is evidenced by the good results of specialist treatment of this condition.

Discussion.—Dr. F. A. E. SILCOCK: In my opinion all dermatologists who report on cases of suspected occupational dermatitis should have personal practical knowledge of the exact industrial job at which the patient has been employed, and it has been my rule to see all manufacturing processes in actual working, so that a first-hand idea of working conditions and hazards should be gauged. Practical knowledge acquired in this manner may be very useful in several ways, e.g.:

- (1) One can estimate the risks of dermatitis.
- (2) In many cases suitable measures for preventing or dealing with dermatitis can be suggested.
- (3) It is obviously important to be able to state in your report that you have personally inspected the exact job on which a patient has been employed.
- (4) You will get an interesting and varied insight into many things, dermatological and otherwise, which will often be of great assistance to you if you can put such "tips" to use in everyday life. I have learnt a tremendous lot from visiting all kinds of industrial works, and have always found both employers and employees helpful and co-operative.

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I will now take these points and briefly explain my meaning.

(1) I was asked to see a severe case of generalized dermatitis, affecting the entire body and limbs and even the conjunctive, in a munition worker. His job was that of degreasing shell-cases. He put dirty, greasy shell-cases on an antiquated three-tiered contraption which he then let down by a rope, with a bump, into a vat of boiling trichlorethylene for a short while, then he hauled them out again on this same apparatus. In doing so he got a spray both of hot trichlorethylene and its vapour, with the result mentioned.

(2) In this case, I suggested altering this manual method of dropping shell-cases into boiling trichlorethylene and substituting a travelling conveyor belt on which the cases could be placed. The belt then went on into the hot degreasing solution and emerged on the other side with the clean dry shell-cases, thus entirely preventing skin contact with liquid or vaporized trichlorethylene.

In a biscuit factory where operatives were having trouble from handling sugar for filling sweet biscuits, the installation was advised of automatic apparatus to supply protective emulsified cream for the operatives to smear over their fingers and hands after washing and before starting work. This apparently met with the desired effect as the trouble ceased.

In another factory, making electrical components, it was the practice to use an X-ray viewing box with a fluorescent screen, under which the part to be examined was placed so that the connexions of the metal wires could be seen and inspected. The operative was in the habit of inspecting several thousands of these parts daily and as sometimes a part when being inspected would drop into the X-ray viewing box, she would lift up the lead protective lid and manually remove the part whilst the X-ray tube was working. X-ray dermatitis of the fingers resulted. It was arranged that the electrical circuit was connected in series with the metal protecting lid and the X-ray tube, so that if the former was lifted up for any purpose it automatically switched off the current to the tube.

(3) With reference to the value of first-hand knowledge, a man employed in cutting out sole-leather had had his left thenar eminence cut off in the machine; a surgeon had performed an excellent job by grafting a full thickness skin graft together with subcutaneous fat from the abdominal wall, but the man claimed that he could not carry on the same job again owing to the anaesthesia present over the newly acquired thumb pad. On investigation, I found that when cutting out the shaped sole-leather it is essential for the operative to hold a specially shaped cutting knife, which is the exact outline of the size of sole required, in both hands and run this over the leather worked upon; whilst doing so he had to feel with the thenar eminences of the hands the surface of the leather for inequalities; when he gets to the desired place he then causes this cutting shape to be pressed through the leather by a mechanical press with considerable force behind it. Only a man who had complete sensation in his fingers and thenar eminences could do this work satisfactorily as the leather must be cut to the best advantage or he will be no good as he would be too wasteful. I therefore gave the verdict in favour of the man.

(4) I have learnt a tremendous lot from visiting factories; I first saw emulsifying bases used to remove grease from soiled knitted fabric at a hosiery factory, hence my interest in triethanolamine, Lanette Wax S.X., &c., which I later advocated in dermatology. Trichlorethylene has been used for some time in factories to remove grease and I have used it for a considerable time to clean skin prior to operating on it, particularly if diathermy is to be used, as it is non-inflammable, an excellent degreaser, superior to ether, and has definite antiseptic properties as well. The higher sulphonated fatty alcohols, lauryl, stearyl and cetyl, are all fully fledged children in industry, whereas they are only now in their teething stage in dermatology, but I would like to forecast a future for them in this latter. Plastics are also another useful line in both industry and medicine.

Dr. W. H. F. Oxley: As a general practitioner, I was hoping to have heard something that would have helped in deciding from the morphology of the lesion whether the disease is industrial or not.

I am interested in this because in wartime dermatologists and examining surgeons should get together and try to reduce the enormous amount of time lost to production owing to dermatological causes. I have learned much from what Dr. Horner has said which I shall hope to disseminate among those who are working in factories on the prevention of industrial diseases. There was a decrease in dermatitis for several years, but during the war the incidence has jumped up and we should do our best to prevent it in the interests of winning the war.

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Dr. J. E. M. WIGLEY: In the most recent publication from America, Industrial Dermatitis, by Schwartz and Tulipan, of New York, the statement is made that the various protective applications of greases are a very temporary and not effective method of solving the problem of protection of the worker. I would like to hear whether Dr. Horner is satisfied that these degreasers are a better proposition than we are led to expect.

Dr. H. W. ALLEN: As a dermatologist I find myself sometimes at variance with the examining surgeon who gives a diagnosis which it is impossible to reverse. I suggest that the making of diagnoses be taken out of the hands of those occupied with the medical inspection of factories and put into the hands of dermatologists; the examining surgeon establishes his diagnosis without difficulty by rapid recourse to the confirmation of a medical referee, who may not be a dermatologist.

Dr. H. Haldin-Davis: The most interesting series of cases I have seen among industrial dermatoses were a number of men affected with "perna disease", i.e. follicular dermatitis with comedones, who were using wires coated with trichlornaphthalene for making railway signal installations. As a rule this disease only affects men concerned in the actual manufacture of this compound.

I do not agree with the speaker who suggested the removal of the diagnosis of industrial dermatitis from the realm of the factory surgeon. His diagnosis is frequently appealed against and can be reversed quite easily. The law provides for the settlement of these cases very cheaply and expeditiously by a medical referee without the necessity of bringing the parties into open court and employing elaborate legal machinery.

Dr. H. W. ALLEN: Surely the diagnosis approved by a medical referee is irreversible. It is only when one goes to court that the diagnosis is altered by the opinion of an expert witness.

The President: As laid down in the Workmen's Compensation Act the certifying surgeon can make a diagnosis and give a certificate, but it can be reversed, and frequently is, by the medical referee. It is the latter's decision which cannot be reversed. There are two defects which, in my view, need correction or amendment in that Act. The first is the long time that may elapse before the victim of a dermatosis receives any sort of monetary compensation, either from National Health Insurance funds or from an insurance company. I have come across cases where the disabled workman was actually penniless before the case was settled. The other is that the Workmen's Compensation Act makes no provision whatsoever for skilled or specialized treatment. If that were incorporated it would largely mitigate some of the hardships with which we are familiar to-day.

Dr. R. KLABER: I should like to ask a question about cutting oils. The ordinary lubricating oils only cause oil acne, and never anything like a true dermatitis, but cutting oils, which seem to be used increasingly, are causing much dermatitis. Are the responsible agents known? And is it possible to substitute one cutting oil for another?

With regard to respirator dermatitis, one wonders whether it is an accelerator or an anti-oxidant in the rubber which is at fault, and whether its use can be entirely, avoided.

Bakelite substances seem to be specially tiresome in the form of liquid varnishes, and one would be interested to know why they are being used so much and whether they are always phenolic resins.

Dr. L. FORMAN: I agree with Dr. Silcock that dermatologists should acquaint 'emselves with the working conditions of the men who are sent to them as cases of industrial dermatitis. A knowledge of the processes involved and of the technical terms and "jargon" of each trade is essential.

I have had the opportunity of visiting two works recently. In a rope-making factory many of the workers had been off duty with boils. They handled fibre, at some stages impregnated with spindle oil. Those workers who took care to cover their legs and arms with thick garments, and particularly those who maintained a good standard of personal cleanliness, were comparatively free. Of the rest, all had varying degrees of oil acne and staphylococcal secondary infection. In a tannery, the men handled alkalies for the removal of hair, and strongly acid tanning solutions. All the men's hands showed a chronic dermatitis; some had more widespread changes.

Simple care and cleanliness of the skin will prevent a high proportion of dermatitis due to oils, dirt, alkalies, and acids.

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In both the above works, facilities for maintaining a reasonable standard of cleanliness did not exist. There were a few dirty washbasins, no towels, no adequate supply of protective for the skin, and no changing rooms.

Even in contact with chemicals to which a specific sensitization would be expected,

cleanliness may prevent this occurring.

During the last war there was a trinitrotoluene factory in Scotland where, during the whole period of its working, there was not a single case of T.N.T. poisoning. It was

done by keeping the factory floor and benches scrupulously clean, and by giving each worker as she came into the works a clean towel, nailbrush, veil, and special gloves and boots for her own personal use; in other words, keeping the skin clean. I have had seven cases of respirator dermatitis, a condition which is very easy to recognize and with which the War Office is familiar. No trouble is experienced when the respirator is changed, providing certain batches of rubber are avoided. The numbers stamped on masks made from these batches of rubber can be obtained from the War Office. It is interesting that the irritant is very easily soluble in saline, and patch tests on the forearm with pieces of moistened cotton wool rubbed on the inside of the rubber part of the respirator, invariably gave positive results, namely, a vesicular or bullous dermatitis.

Dr. W. N. GOLDSMITH: One should make every effort to visit factories when possible, as otherwise even the expert dermatologist is likely to make mistakes in diagnosis. As a result of a recent visit to a cigarette factory and my request that they should send me all their cases of apparent tobacco dermatitis, and not merely the doubtful ones, I learnt for instance that the characteristic distribution was the bend of the elbows and the back of the neck. It hardly ever involved the hands, though the affected workers were usually "strippers". It attacks almost exclusively new workers after a few weeks and disappears rapidly if they stay away from work. They are then generally able to resume it with impunity.

Dr. Sherry-Dotteringe: I should like to ask Dr. Horner whether in this war cases of trinitrotoluene poisoning have increased or are very much less than in the last war and, if there is a decrease, can it be due to preventive cleanliness, or is there some

secret which we have not been told? I have been working in a rubber research works and have been rather fortunate in seeing some cases caused by irritating dust within twenty-four hours of a rash appearing. Research workers gave a history of itching and faint erythema, which passes off if washed immediately. Workers who do not take these steps go on to a more

severe attack which clears up when given other work for a few days. In two cases that went on to exfoliative dermatitis it was found that the patients had given themselves a good rub with sulphur ointment. That was only discovered after great difficulty, and I wonder whether most of the severe trade dermatitis seen in hospital might have been aggravated by home treatment.

Dr. W. GRIFFITH: My experience is that many factories have medical officers and a surgery with trained nurses, and it would obviously be a great boon if this system was extended. We regularly have nurses sent down to St. John's Hospital for Diseases of the Skin from the College of Nursing during their training as industrial nurses.

Some employers have informed me that doctors have told them that there is a way of de-sensitizing patients, or making them immune from dermatitis. I must confess I was rather sceptical. I would like to ask Dr. Horner whether she knows of any system of injection or otherwise which would make a patient immune from acquiring dermatitis.

Dr. T. O. GARLAND: I also consider that dermatologists should go more often into factories. Doctors should not be continually giving opinions on industrial diseases or accidents without seeing the site of the accident or disease. Our whole profession needs more direct linking with production. It should be appreciated that it is very difficult to day for workers to get any accurate information on the dangers of the materials they handle. Our profession has a long-neglected duty to remedy this ignorance. Many employers can also be described as "unthinking". In this room recently I heard described an employer who asked that some ointment should be used in the prevention of dermatitis, which he claimed would also cure nystagmus. Doctors, too, are not guiltless. Some shop stewards recently told me of a doctor who had declared that their job of degreasing metal spars over an open bath of trichlorethylene held no possible dangers for them.

Dr. R. T. BRAIN: There is just one aspect which has not been touched upon: that is the use and nature of protectives. Are the protective agents proprietary preparations

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or are there others in use which are not patented, and do they themselves irritate the skin? We are now very interested in the increasing use of emulsifying agents. Has Dr. Horner seen any ill-effects from these agents upon normal skin and could she tell us whether different preparations are used to protect from grease or from water?

Although cleanliness is desirable if the workman is using an irritant, yet in many other occupations a little wholesome dirt does less harm than frequent cleansing.

Dr. F. W. Jacobson: Has Dr. Horner observed whether patients with a trifling degree of neuro-dermatitis, eczema or psoriasis, are more prone to develop industrial dermatitis? I am thinking of "atopic" dermatitis and am not quite clear whether it is only in the imagination of Coca and his pupils or a fact that a family history of hay-fever and chronic asthma predisposes to industrial dermatitis. Is care taken before workers are accepted in factories where there is special risk of dermatitis to examine and if necessary to weed out those who give a personal or family history of "atopic" dermatitis, asthma, hay-fever, or migraine?

The President: I think your question was answered by the word "selection" used by Dr. Horner.

Dr. JACOBSON: Does it go so far as the family history?

Dr. Silcock (in reply) said: A question was asked regarding the unfortunate man waiting for his compensation. In Leicester and neighbourhood I have got over that difficulty by arrangement with the Friendly Societies who advance the man his wages on his signing that he will refund if he does not get compensation.

With regard to the entry to factories. I have not had the least difficulty. Dr. Klaber asked about cutting oil: I see much dermatitis from it, but I have also seen people who have worked for many years without difficulty with sternol cutting oil, and when they are put on high-speed steel and use sulphurized cutting oil they get dermatitis and have to finish. Another irritant is the suds which are a mixture of caustic soda and soap.

Dr. Horner in reply to the different queries put to her in the course of the meeting, said that entry to factories was only by authorized pass. For the prevention of dermatitis in industry a properly chosen and correctly applied barrier substance was effective.

The term "Selection" in wartime meant selection from among the personnel available.

Emulsions of oil in water and mineral oils in contact with the skin gave rise to different reactions.

There was at the Royal Society of Medicine in April, 1942, and recorded in the *Proceedings* a full discussion of the effects of T.N.T. (*Proc. Roy. Soc. Med.*, 34, 553, Sect. Therap., 19.)

Dr. Horner had noticed in many cases of dermatitis among strippers (tobacco) the same distribution as Dr. Goldsmith had observed, but a recurrence in these cases was not uncommon. She knew of nothing which gave immunity from a recurrence of dermatitis. However, the incidence of such recurrence could be lessened by early diagnosis, specialized treatment. A return to the original work should be permitted only after a period of convalescence of the skin. Of course, the co-operation of the person concerned was necessary to secure a good and lasting result.

# Section of Orthopædics

President—C. Lambrinudi, F.R.C.S.

[February 21, 1942]

MEETING AT THE ROYAL NATIONAL ORTHOPÆDIC HOSPITAL

# The Treatment of Spinal Injuries with Nervous Involvement

By K. I. NISSEN, F.R.C.S.

Since the onset of the war, some forty-five cases of traumatic paraplegia have been admitted to Stanmore. With the exception of ten gunshot wounds, the injuries have been of the type commonly met with in heavy industry. A number of patients, however, have lost their homes and near relatives, and have shown little desire to recover. Though the majority have come from the London area, only a handful have been transferred within the first week. As a result, few cases of the early recovery so common in general hospital practice have been seen. A number have had the bony deformity well corrected, but at considerable cost. Two such cases were received ten days after their air-raid injuries. Parts of their sodden plaster jackets had been removed to provide access for suprapubic drainage. Pressure sores covered the sacral and lumbar spines. One of these women had a urinary dermatitis extending up to the scalp and died the next day. The other is now able to walk but has had serious renal infection. These distressing cases emphasize the need for orthopædic treatment in harmony with the nursing care of the bladder, the bowels, and the back.

Before coming to the general care of paraplegic patients, brief mention may be made of those cases in which an immediate surgical procedure may be considered, as for instance, in gunshot wounds and in fractures of the laminæ. Enthusiasm for operation is tempered by the fact that, whatever the subsequent treatment, no cord lesion which is still complete after forty-eight hours shows a useful degree of recovery. This holds true whether a bony lesion is present or not, and is also true when depressed fractures of the laminæ or small fragments of metal invite operation. The prognosis in severe lesions of the cauda equina can seldom be given so early, but no case of successful suture has yet been recorded in

this country

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Of eight gunshot wounds with severe paralysis, two had missiles removed from the neural canal. In one case the cord was severely bruised while in the other it was divided. Both cases died within a week. The other six were left alone and all have survived without

local complications from retention of the metallic fragments.

The question of operation again arises when fracture-dislocation of the lumbar spine is suspected. Two joints and four articular processes are involved, and the expected combinations of dislocation with or without fracture of the denticles are actually found. Critical X-rays are necessary to exclude unilateral or bilateral fracture of the articular processes in which there may be no posterior obstacle to reduction by closed manipulation. On the other hand these simple manœuvres alone are useless in bilateral dislocations with intact and interlocked facets. Hyperextension may elevate the anterosuperior fragment of the body of the inferior vertebra, but with separation. When the jacket is discontinued,

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or even sooner, marked wedging recurs with angulation of the theca. It is commonly believed that hyperextension of an unreduced fracture-dislocation may increase the paralysis immediately. Cases occur, however, where the paralysis ultimately resolves despite this treatment, and there is no doubt that reduction improves the stability of the spine rather than the immediate prognosis of the paralysis. Post-mortem specimens also show that reduced posterior intervertebral joints may ossify firmly, giving the effect of a localized spinal fusion.

The mechanism to be used in reduction is logical. The locked position is one of recoil. When recoil is only partial, the widely separated articular processes are plainly visible in the X-ray films and suggest how considerable the displacement may be at the time of impact. A cautious reversal of the mechanism of injury may therefore be employed in reduction and the spine well flexed over a broken operating table after exposure of the region under general anæsthesia. It may be possible then carefully to lever back the intact articular processes, while backward traction on the superior spinous process is maintained. If an articular facet still hinders reduction, as little as possible should be removed. Complete excision of a facet seriously impairs the posterior stability of the spine, and if the spinal jacket cannot be maintained for any reason the deformity is liable to recur.

Reduction may not occur even when any posterior bony obstacle has been removed. Hyperextension has not been found effective at this stage. The posterior border of the superior body only hinges well forward on the upper table of the lower vertebra. The displacement between the bodies may be reduced by strong pressure in opposite directions on the upper and lower segments with the spine well flexed. Only when reduction has been seen should hyperextension be applied to maintain it. Local anæsthesia may serve well for operative exposure but is not suitable for subsequent manipulations.

Only five cases of fractured cervical spine with paraplegia have been treated. Respiration is almost entirely diaphragmatic and a mechanical respirator should be available. Cases of high cord involvement suffer respiratory distress when prone, and the face down position for transport is contra-indicated. In general no harm has come from transport

with the patient on his back except during the evacuation from Dunkirk.

Whether operation is performed or not, the patient usually has to receive immobilization of the fracture, compatible with full nursing care over a period of months. Many are treated in a plaster jacket. The level of complete anæsthesia is most important in determining whether a jacket, with its risk of pressure sores, should be applied. When the level extends higher than the groin, the risk is so great that it exceeds the doubtful value of correction and of the patient's mobility. Jackets were applied very carefully in three cases with complete anæsthesia to a level between the pubis and umbilicus, but in spite of frequent turning superficial sores developed in the usual places. After six weeks deep sloughs down to the ischial tuberosities suddenly appeared and the jackets had to be abandoned in favour of plaster beds. The retention of posterior column sensibility, however, reduces the tendency to pressure sores so very considerably that reduction and the application of a jacket may be regarded as safe. Post-mortem specimens of compression fractures show that the greatest thecal deformity occurs at a dense transverse ridge formed by the collapsed annulus fibrosus bulging backwards into the neural canal. Hyperextension affords an opportunity for restoration of the disc space which should on no account be missed when the cord is only partly damaged.

The padding of plaster jackets is important. Small pieces of adhesive felt are entirely madequate and frequently shift off the bony prominences, while bulky padding makes for uneven creases and ridges. A stockinet vest, with a half thickness of white wool from the usual blue roll over the iliac crest and spines and a full thickness of white wool down the spinous processes, is generally satisfactory. Many jackets applied elsewhere showed marked transverse ridging from the hasty application of the jacket before full hyperextension had occurred. The strain on the arms and shoulders during reduction by Watson-Jones' two-table method can be much reduced by using pulleys and a sling, which should ride high in the axilla and so not interfere with the application of the sternal plate. The side of the patient's bed makes a convenient lower table, and if the sling is applied with the patient lying prone, he may be slung into position like a piece of cargo with the greatest of ease. The sling is invaluable when injuries to the upper limb and shoulder girdle are present.

The pubic part of the average plaster jacket does not extend downwards actually over the surface of the pubic bone. This is probably a legacy from the illustrations of Böhler and Schnek in which the diagrams indicate the need for support over the pubis, but photographs of patients show the jackets trimmed at the level of the pubic crest.

This downward extension is most important when suprapubic cystostomy has been performed or is required. A window extending from the pubic crest to the umbilicus can be made and its reinforced margins protected with vaseline gauze. The operation can be performed without soiling the cast, and with reasonable care the jacket may last two or even three months without becoming sodden from leakage of urine. Such patients may get up in a chair or attempt walking with the catheter spigoted.

Persistent vomiting and abdominal distension may occur after the application of a jacket to any case of spinal injury. In uncomplicated fractures it is common after the application of a second plaster jacket, particularly when the patient has not been doing abdominal exercises. Again it may occur when reduction has been delayed several days in a patient confined to bed since the accident. The relative frequency in cases with nervous involvement is much greater. Poor tone in the abdominal muscles is common to all these patients and is probably a much more important factor than injections of morphia or omnopon. The vomiting usually occurs some hours after reduction, but may be precipitated (after a week or more) by some minor upset such as an indigestible meal. Minor degrees of vomiting may be overlooked; but if it is very severe with marked dehydration and wasting, intermittent gastric syphonage, continuous intravenous salines and removal of the jacket are then indicated. In cases which are likely to develop this complication the surgeon should be content with a lesser degree of hyperextension.

Patients unsuitable for a plaster jacket usually have serious cord involvement at or above the 9th dorsal vertebra and may have complications such as pressure sores or urinary sepsis as well. For these difficult cases the full length plaster bed has been found most satisfactory, especially for the first six weeks. Its development proceeded naturally from the satisfactory nursing of Pott's paraplegia in plaster beds. The short beds described in most works on fractures have some serious disadvantages for heavy cases. They are not mounted on blocks and hence are easily soiled by the incontinent patient. If made in hyperextension they are prone to cause pressure sores after two or three weeks when the spinal muscles commence to waste. When used in conjunction with Braun's splints, the skeletal traction interferes with the accurate fitting of the cast and with the daily routine of full passive movement of all joints.

The value of evenly distributed pressure in the prophylaxis and treatment of pressure sores is well recognized, but this ideal is very difficult to obtain. The usual technique of making plaster beds has been modified considerably, but has already been described in the Pressedness (Press Rep. See Med. 24.457 [Sect. Surg. 27])

in the *Proceedings* (*Proc. Roy. Soc. Med.*, 34, 457 [Sect. Surg., 27]).

A full-length bed is very comfortable. The nursing care could hardly be simpler. A bedpan is constantly in position, and with the exceptions of dribbling incontinence in women, extensive pressure sores and very hot weather, the bed keeps clean and sweet. The gutters for the lower limbs avoid deformity and allow ready access for physical treatment. Patients with sores are turned out once a week. They are washed with soap and water, given an exposure to ultra-violet light, dressed with dry gauze and returned to their freshly lined beds. Sores respond well to this simple and economical treatment. Transport is greatly facilitated and the constant level is an aid to the smooth working of tidal drainage.

The disadvantages of a good full-length bed are few, the chief one being that the supine attitude favours urinary calculi. Flexor spasms make any form of nursing difficult and this is no exception. Rapid wasting in flaccid paraplegia may require early renewal of the bed. These beds, however, require some skill to make and as small errors in technique can make them thoroughly unsatisfactory they are not likely to win general favour. A water bed or a sorbo mattress are satisfactory alternatives as soon as excretion is under control.

Complete relief from pressure on the sacrum may be obtained by transfixing the iliac crests with Steinmann's pins or Kirschner wires and applying vertical traction. This has been done in only one case, but a sacral sore 3 in. in diameter and over an inch deep healed in six weeks. The pin holes may, however, form tender adherent scars.

The treatment of the bladder still remains a vexed question. Manual expression and the allowing of overflow incontinence seem to be out of favour. Cases admitted with indwelling catheters have seldom been free from sepsis, which indeed can be expected to be severe after a fortnight. Yet Frank Kidd, using a few simple precautions, found this form of drainage very successful in the last war.

Tidal drainage is a variation on the theme of the indwelling catheter. We have used the simple methods of Lawrie and Nathan and of Belliss rather than Munro's complicated apparatus, but with little real success. [Since this paper was written, Stewart's modification of the Belliss apparatus, incorporating a cystometer, has been used and found very

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satisfactory.] Unfortunately the opportunity to use tidal drainage from the beginning has not yet arisen in this Centre. The longest time it has been used in a patient starting free from sepsis is fifty-eight days, with evidence of infection developing over the last week. Even four to six weeks should afford an opportunity for cases of transient paralysis to regain control or for reflex micturition to commence. We have had no cases of tidal drainage with early recovery, and the patients who have developed reflex micturition have been women. They finally had suprapublic drainage, which in women is easier to manage than truly reflex micturition. No case admitted with urinary sepsis has cleared up with tidal drainage. The method will receive enthusiastic support only in those centres with an expeditious system of transfer and meticulous general supervision.

Suprapubic drainage is the last resort in cases with urinary sepsis, and delay may be fatal. It is a simple and satisfactory treatment for cases which in time recover control, for the fistula soon closes when the tube is withdrawn. On the other hand it destroys any chance of reflex micturition in permanent paraplegia. Neurologists deplore this, but many urologists maintain that suprapubic drainage is preferable especially in women. The tube should be inserted midway between the pubis and umbilicus so as to give a sloping track. The fistula then does not become adherent to the pubis and leakage is minimal. A plaster jacket can be applied if necessary. As an initial treatment suprapubic drainage should certainly be used when the conditions of nursing care and transport are gravely disturbed. It is too frequently postponed when sepsis has arisen.

Hopelessly paralysed cases are all too frequent. Flexor spasms can give rise to grave discomfort. Flaccid cases are so comfortable in comparison that the destruction of cord function below the level of the lesion, even at the cost of reflex micturition, should be considered. In some cases of paraplegia the misery of the patient is such that one cannot forget the injunction "Thou shalt not kill; but need'st not strive officiously to keep alive".

### Some Minor Fractures in the Hand

By V. H. Ellis, F.R.C.S.

FRACTURE OF THE CUNEIFORM OR TRIQUETRAL BONE

Greening (1942) found 20 fractures of the cuneiform in 580 fractures of the wrist, and in the present series 9 have been found in 1,000 consecutive but unclassified fractures, i.e. about 1%. It is not an unimportant fracture, as the disability is considerable both in severity and duration. Although the cuneiform bone of the wrist may be comminuted by a fall on the hand, as in one case in this series, more commonly a fragment is torn from the dorsum of the bone, forming one of the class of sprain fractures. Two strong ligaments are attached to the bone, one from the semilunar, the other from the styloid process of the ulna; fractures, therefore, result from perilunar dislocation of the carpus and from forcible palmar flexion of the wrist.

Diagnosis.—The sprain fracture is not visible in an antero-posterior X-ray of the wrist, and although it is clearly shown in the lateral view the fragment may appear to be a portion of the semilunar. The site of tenderness on the ulnar side of the carpus is adequate evidence of its origin and this is confirmed in a slightly oblique X-ray. The wrist is frequently swollen, and movements, particularly palmar flexion, are restricted by pain.

Mechanism.—The mechanism of production is uncertain. In all cases it was due to a fall upon the hand, but in none was it associated with a Colles's fracture (except of the other wrist). In one case there was a spiral fracture of the 4th metacarpal bone and in another there had been a Smith's fracture of the injured wrist two years previously. Probably therefore forced flexion of the wrist is responsible.

Treatment.—Neglect of treatment, or simple strapping as for a sprain, is apt to produce a disability sufficient to prevent heavy manual labour for two to three months and perhaps longer. Immobilization in a plaster of the scaphoid type, but with some ulnar deviation, seems to be the best form of treatment. This may allow continuity of work. The plaster should be maintained for five weeks and be followed by exercises to restore movement. Union does not always occur and the fragment may sclerose (fig. 1), but this does not seem to prevent full painless function.

Results.—Of this series of 9 cases: One comminuted fracture was in plaster two months and discharged with full function in four months; eight cases immobilized for an average of four and a half weeks were discharged after an average of eight weeks; two had a disability preventing return to original heavy work.



FIG. 1.-Fracture of carpal cuneiform.



FIG. 2.-Fracture of sesamoid.

#### FRACTURE OF A SESAMOID BONE OF THE THUMB

In Scobie's case (1941), it was presumed that the bone was crushed by direct violence. In the writer's case the patient fell dislocating the thumb. She reduced the dislocation herself but there was subsequent swelling and tenderness over the ulnar sesamoid. This bone was apparently transversely fractured by traction (fig. 2). There are therefore probably two forms of fracture comparable to those found in the patiella. The thumb was splinted in flexion on Kramer wire for six weeks and the patient was discharged to her original domestic work after two months.

References.—GREENING, W. P. (1942), Brit. M. J. (i), 221. SCOBIE, W. H. (1941), ibid. (ii), 912.

#### [April 11, 1942]

### MEETING AT ST. NICHOLAS' ORTHOPÆDIC HOSPITAL

# Practical Points in Connexion with Amputations

By George Perkins, M.C.

THESE remarks apply only to final amputations done through uninfected tissues with a reasonable certainty of primary healing.

### SITES OF ELECTION

Skilful limb-makers can fit artificial limbs to stumps of any length or shape, but they tell us that certain limbs look better and function better than other limbs, and that they can only fit these good limbs to stumps of a certain length; and in the matter of amputations surgeons must resign themselves to take orders from the experienced limb-makers. There is no doubt about their experience; at the limb-fitting centre at Roehampton for example they have fitted 40,000 leg amputees since the last war, and have already in this war supplied 1,123 limbs. Their conclusions are roughly these:

(1) End-bearing stumps do not last. The majority of pensioners of the Great War with Syme and transcondylar amputations—amputations designed to take end-bearing—have required reamputation at a higher level. It should be noted, however, that this conclusion is not accepted by our Canadian cousins, who consider that in the lower limb the Syme and the Stokes-Gritti amputations are to be preferred to all others. It may be that the Canadian limb-makers produce a better limb than we in this country; the fact remains that the limbs evolved by British limb-makers for amputations at these two levels are unsatisfactory.

(2) The shorter the stump, the less trouble it gives. The troubles are mostly circulatory. The end of a long stump becomes cold, blue and congested, and finally ulcerates; and stumps a trifle shorter suffer in proportion to their length.

- (3) The stump must be long enough to remain within the socket during movement.
- (4) The stump must be long enough to contain the insertion of the muscles activating the joint above the amputation.
- (5) The stump must not have a bulbous extremity; otherwise it will not fit inside a conical socket.
- Applying these theoretical conclusions, the limb-makers tell us that there are two sites of election in the arm and two in the leg. In the leg, one is above and one below the knee—the above-knee amputation and the below-knee amputation. In the arm one is above the elbow and the other below, the above-elbow and below-elbow amputation.
- Above-knee amputation.—The ideal length for an above-knee stump is between 10 in, and 12 in., depending on the height of the patient. The measurement is made from the top of the great trochanter to the end of the femur.
- A stump shorter than this is not so good, because, the main adductor muscle being inserted all the way down the shaft of the femur, a short femoral stump is deficient in adductor power and the unopposed abductor muscles hold the artificial leg abducted.
- A short stump is difficult to retain inside the socket when the patient flexes his hip actively, especially if the subcutaneous tissues are bulky, and it is often necessary to fit a shoulder-controlled limb instead of a stump-controlled limb. Shoulder-control and stump-control are two terms used by limb-makers and require definition. There are two ways of activating an artificial leg. In one, the patient lifts his limb off the floor by tiptoeing on the other foot. Once the limb is off the ground, the patient by shrugging his shoulders applies tension to shoulder braces attached to the limb and thereby flexes the hip-joint. The flexor muscles of the hip are inert and the stump therefore does not tend to leave the socket. This method—shoulder-control—produces an ungainly gait, and new amputees are being fitted whenever possible with stump-controlled limbs. In the stump-control method the hip is moved actively by its own muscles; whenever the limb is being advanced the hip flexors go into action, and if the stump is short the stump tends to come forward out of the socket.
- When the stump is less than 6 in. it is not practical to fit an above-knee limb, and the patient has to put up with a tilting-table limb. This limb has an artificial hip as well as an artificial knee. But although the patient's hip is not used the limb-makers like left 4 in. of the shaft of the femur measured from the top of the trochanter. This small piece of femur when flexed to a right angle provides a boss of bone anteriorly (the end of the stump) and a boss of bone laterally (the great trochanter) round which to mould the pelvic socket. These bosses prevent the socket from rotating on the pelvis.
  - In an above-knee limb weight is transmitted through the tuber ischii.
- Below-knee amputation.—The ideal length of a below-knee stump is 5½ in., measured from the inner joint line to the end of the tibia.
- All the muscles that control the knee are inserted high on the tibia, so that from the point of view of muscle control a below-knee stump need not be more than 2 in. in length. But, unless the stump measures at least 4 in. it will not remain inside the socket when the knee flexes. And, on the assumption that the shorter the stump the less trouble it gives, it would appear that 4 in. of tibia should be the aim. Two other considerations, however, affect the decision: The Royal Warrant lays down that the pension for a man with a stump of less than 4 in. is higher than when the stump is longer than 4 in. This dates from the time when it was thought that 7 in. was the ideal length. Therefore to avoid argument, it is better for the stump to be longer than 4 in. The second and practical consideration is that a below-knee amputation is difficult to perform satisfactorily; so often the skin gapes and the wound heals by granulation tissue leaving a wide, poorly nourished scar. It is better therefore to start with a tibia longer than necessary so that if a trimming operation has to be done later a portion of the bone can be sacrificed to enable the skin edges to be sutured without tension.
- For these reasons the ideal length for a below-knee amputation is declared to be  $5\frac{1}{2}$  in. It is not universally appreciated that the limb-makers have made a change in the site of election, and the general belief is that a satisfactory below-knee limb cannot be fitted to a stump shorter than 7 in. As a matter of fact the limb-fitting surgeons at Roehampton prefer a 4 in. tibial stump to one of  $5\frac{1}{2}$  in.
- Not only has there been a change in the ideal site for amputation, but also in the method of weight-bearing. Hitherto it has been customary for a below-knee amputee to take weight under the expanded upper end of the tibia and the head of the fibula. Experience has shown that these bearing points after a few years develop painful bursæ, and more and more below-knee stumps are being fitted from the beginning with a long thigh corset taking a bearing under the tuber ischii.
- Below-elbow amputation.—The ideal length for a below-elbow stump is 7 in. measured from the tip of the olecranon to the end of the ulna.
- In theory it would seem advisable to retain the lower radio-ulnar joint so as to preserve active rotation of the forearm. In practice, however, if the socket is loose enough

to accommodate the change of shape in the forearm during rotation it is too loose to fit the stump. An amputee cannot rotate his forearm when wearing a limb although he may be able to do so when not wearing a limb.

The muscles controlling the elbow are inserted high in the forearm so that the factor of muscle control is of no importance in determining the length of a below-elbow stump.

Nor does a long below-elbow stump suffer to the same extent from vascular disturbances as a long below-knee stump; so that it would seem immaterial what length is chosen. The advantage, however, of having a shortish stump is that appliances can be brought nearer the elbow and thereby can be better controlled. The shorter the stump the better, from this point of view, but the stump must be long enough to get a good purchase on the socket of the limb. Therefore a length of 7 in. is chosen as the ideal. The length should not be less than 4 in. because a stump shorter than this cannot be retained in the socket when the elbow is flexed.

Above-elbow amputation.—The ideal length for an above-elbow stump is 8 in., measured from the point of the acromion process. The only consideration in deciding the length of an above-elbow stump is that the bone section should be made above where the shaft begins to widen. An amputation through or close to the elbow presents a bulbous bony extremity, and the club-shaped stump will not fit into a conical metal socket. The socket has in consequence to be made of split leather which is laced up after the stump is laid in it; such a socket is heavy, clumsy and hot. A length of at least 6 in, is needed to retain the stump inside the socket. The extra 2 in. suffices to hold the stump securely. More is not needed, and a total length of 8 in. ensures that the bone is divided through the narrow part of the shaft and leaves sufficient room for the fitting of the artificial elbow at its natural level.

#### SITUATION OF THE SCAR

Formerly, when end-bearing was the vogue, great pains were taken to avoid a terminal scar. By cutting unequal flaps the scar was located an inch or more away from the end, usually on the posterior surface. In the modern artificial limb the socket does not make contact with the end of the stump, and a terminal scar far from being objectionable is an advantage, since in this situation it is shielded from pressure.

I use equal antero-posterior flaps for all four amputations. In the arm this gives a central terminal scar and in the leg a terminal scar that lies just behind the bone. Flaps of equal length have perimeters of the same length and the two edges can be sutured together without furrows. It is an advantage, also, to make the flaps semicircular rather than square, for this gives a conical shape to the stump right from the beginning and shortens the time spent afterwards in shaping the stump by bandage or pylon.

The limb-fitting surgeons at Roehampton do not like a scar over the front of the tibia, nor in a below-knee amputation do they like an antero-posterior scar, which is apt to be drawn up between the tibia and fibula forming a sulcus which readily develops an intertrigo. With these two exceptions they do not much mind where the scar is.

Length of flaps.—The length of the flaps should equal the diameter of the limb, so that at the end of the operation the two flaps fall together and just meet. One is courting disaster if the least tension has to be applied to approximate the edges. In arm amputations I find I am inclined to cut flaps too long, and in leg amputations too short, particularly in below-knee amputations. When the muscles are cut through at the same level as the bone—as they should be—one need never be afraid of having excess skin in a below-knee amputation. [Women have more subcutaneous tissue than men, and the thicker the subcutaneous layer the less the need for ample skin.]

Mobile scar.—It is important to obtain a non-adherent scar. When an amputee wears an artificial leg there is a continual up-and-down movement of the limb on the stump as he takes weight on and off the leg. This up-and-down movement is known as piston action. Movement between the socket and the skin is negligible and piston action takes place between the skin and the underlying tissues. When the skin is attached to the underlying muscles the piston action is communicated to the soft tissues and the neuromata are repeatedly pulled upon and become painful. Incidentally, a scar adherent to bone is much less troublesome than a scar adherent to muscle; a guillotine stump for instance when finally healed can often be satisfactorily fitted with a limb in spite of a large circular papery terminal scar.

The difficulty is how to ensure that the scar shall not adhere to the muscles. I endeavour to do this by cutting through the deep fascia at the same level as the skin and reflecting it back with the skin; and at the end of the amputation I cover in the raw bone and the raw muscles by sewing over them the deep fascia.

Muscles.—For many years now limb-makers have been asking surgeons not to cover the end of the bone with muscle, since this leaves a baggy uncontrollable mass which can only with difficulty be inserted into the conical socket. The muscles should be cut

through at the same level as the bone. It would seem unnecessary to mention this were it not that one still sees stumps in which the muscles have been left long and sewn

over the end of the bone.

There is, however, one point of interest regarding the muscles. In using an above-knee limb the adductor muscles are of great importance, and for some time I have been searching for a method of attaching the huge belly of the adductor magnus to the femur in order to preserve its length and therefore its power. As it is, the muscle retracts and, not having a lower fixation to bone, is of little use as an adductor. So far I have not been successful, and I wish some of you would consider the problem when next doing an above-knee amputation.

Nerves.—Neuromata form inevitably whenever nerves are cut across. Neuromata elsewhere in the body are usually not tender; in a stump they may be. The possible causes for the tenderness are: (1) Pressure from the socket of the limb; (2) irritation from neighbouring fibrous tissue; the result of past sepsis or of maltreatment of the nerve at the time of the amputation; and (3) repeated traction from piston action when the skin is adherent to the underlying muscles. By reviewing the possible causes one is

in a better position to counter them,

It is, I believe, the usual practice to cut the nerves shorter than the muscles. This dates from the time when end-bearing was the aim, the idea being to remove the neuromata from the end of the stump. But in the modern limb the end of the stump is not in contact with the socket; and I hold therefore that it is better not to shorten the nerves, since they are more liable to be pressed on by the socket if shortened than if left long. Many surgeons, besides pulling on the nerves to shorten them, clamp and ligature them and sometimes in addition inject them with alcohol. All these proceedings are traumatic and likely to increase the amount of scar around the nerves. I believe it best to leave the nerves alone; if the surgeon does not even know where they are, so much the better. The third cause for tenderness—traction from piston action—can be avoided by getting a non-adherent scar.

Tender neuromata are less common than they were. In the past year at Rochampton I have only once operated for a tender neuroma; whereas I am under the impression that at Shepherd's Bush, after the last war, a week rarely passed without one or more operations on neuromata. I have been told that it is too early yet to expect them in this war. Feeling as I do that an adherent skin scar is the most potent causal factor, I believe that, should operation become necessary, it is better to remove a portion of the main trunk of the nerve well above the tender area rather than excise the neuroma itself, for the end of the nerve will certainly become adherent to the operation wound if the

neuroma has been approached through scar tissue.

Hæmostasis.—In amputations as much care should be paid to controlling hæmorrhages as in operations inside the skull or the abdomen. It is a tedious business to check innumerable small bleeding points, for no sooner have a score or so been clamped and tied (or seared with diathermy) than a score of others appear. Nevertheless time spent in securing hæmostasis is time well spent, especially in a below-knee amputation. Pulling apart of the skin edges, sloughing of the edges, and sepsis—the three bugbears that ruin an amputation—rarely occur if a hæmatoma is avoided.

As well as taking infinite pains to ligate all bleeding points however small, it is advisable to apply pressure to the end of the stump. I use two long strips of elastoplast over a moderate amount of dressing. This seems to me more effective than a pressure

bandage applied over a large mass of wool.

Drainage.—Coming to the vexed question of drainage: I feel safer when I have drained, yet I cannot remember having seen a drain do any good. Should hæmorrhage occur, a drain does not function, for the blood clots and does not flow out. My present practice is not to drain unless I am apprehensive of sepsis, and then to leave the drain in several days so as to facilitate a channel for the exit of pus should it form.

#### POST-OPERATIVE TREATMENT

The task of the surgeon ought not to finish with the healing of the wound. It is his further duty to prepare the stump for the artificial limb, and also to prepare the patient

for using the limb-two distinct processes.

The stump in its immediate post-operative state is too large and is the wrong shape; it is required to convert a wide cylinder into a narrow cone. Time alone will effect this, but the process can be hastened (a) by bandaging or (b) by the wearing of a temporary prosthesis. The limb-fitting surgeons at Roehampton prefer the first to the second method. The bandage method has the advantage that it can be started as soon as the wound has healed. Crêpe bandages are used, and two are sewn end to end to form one long bandage. They should be 6 in. wide for an above-knee stump and 4 in. for all other stumps. The principle of the method is to compress the stump from below up,

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the maximum pressure being exerted at the distal end. The bandage is applied much as one applies an ordinary stump bandage; for the pressure to be effective, however, the bandage must first be rolled very tightly and then applied under the greatest possible tension. The bandage needs reapplying several times a day. One of the disadvantages of the pylon method is that the socket, as ordinarily made, fits the shape of the stump as it is and not as one hopes it to be, so that although the stump shrinks it does not shrink to the right shape.

The first post-operative task, therefore, is the preparation of the stump; the second is the preparation of the patient. After an amputation the muscles of the stump, deprived of their natural function, waste and lose their physiological connexion with the central nervous system. Moreover the joint above the amputation is apt to be held flexed and to become fixed in that position. The muscles must be strengthened, and employed in order that the amputee does not forget their existence. I consider this treatment—rehabilitation it may be called—most important. The patients are taught to exercise their stump muscles against the resistance of a weight working over a pulley. In an above-knee amputation, particular attention is paid to the hip extensors and the hip adductors; in a below-knee amputation, to the quadriceps. Also, the patient is made to move the joint above the amputation fully in all directions. Massage is deprecated, partly because it irritates the cut nerves, but chiefly from a psychological standpoint; the patient should learn to do something for himself and not rely on something done for him.

The patient is encouraged to move his stump voluntarily as soon as he will, and not to hold it immobile and inert; and of course the stump should not be propped up on a pillow. As soon as the wound has healed, the patient is sent to the gymnasium where in concert with others he exercises the stump muscles, and after the exercise he is shown by the masseur how to bandage the stump correctly.

The sooner a limb can be fitted the better, since it shortens the time during which the crippled limb is out of action. It is usually possible to fit an artificial leg in three months from the healing of the wound, and an artificial arm in six weeks. Shrinkage may not be complete by this time and the original socket may ultimately be too big, but it is better to spend extra money on a new socket than to delay the fitting of the limb.

Teaching the patient to use his limb.—When the patient has at last been fitted with his limb it is the surgeon's business to supervise his first attempts at walking. At present this is being done by the fitter, who cannot be expected to know much about the mechanics of walking; and the patient so frequently acquires faulty habits in learning to walk. The patient should be returned to us when he is "passed out" with his limb, for we do know that it is absurd to try and walk without being able to stand on one leg, and we do know what muscles the patient should activate. The aim is to get the amputee walking without a limp—an aim easy to achieve if the patient is properly taught.

Cineplastic amputations.—The young surgeon with an ingenious mind is tempted to try his hand at cineplastic amputations. He should remember, however, that (1) the muscle activators have neither sufficient range nor sufficient power to be of practical use; (2) the limb-makers cannot make suitable limbs for cineplastic amputees; (3) all the British patients who had cineplastic amputations after the last war have been reamputated; (4) the Italian surgeons who introduced and popularized the method have given it up.

#### AMPUTATIONS IN CHILDREN

It is customary to fit children with peg-legs, and to withhold artificial limbs until they have ceased to grow. This is done on the score of expense and because it is supposed that the limb-makers cannot make limbs for children. At Roehampton the limb-makers fit children from the age of 3. The limbs are made telescopic and can be lengthened as the child grows. Psychologically it is important to make a child like other children, and a child fitted with an artificial limb walks perfectly. Moreover once the peg-leg gait is acquired it is difficult to eradicate. Therefore every effort should be made to give children proper artificial limbs.

#### THE DIFFICULTY OF THE BELOW-KNEE AMPUTATION

Amputations vary in their ease of performance. Both arm amputations are easy to do and may be relegated to a house surgeon, the above-knee amputation is relatively easy and is well within the compass of a registrar, the below-knee amputation is difficult and should only be done by the expert.

Long-arm retractor.—I have found a long-arm retractor useful. It is three feet long and hinged so that it fits inside a sterilizer. The sharp right-angled prong is inserted into the medulla of the bone and an orderly, standing at the head of the patient, holds the handle and raises the limb to the vertical and so exposes to view the raw surfaces. In my experience the retractor does not cause bleeding from the medulla.

## The Prophylaxis and Treatment of the Stiff Knee Following Fracture of the Femur. (Abridged)

By ROBERT H. YOUNG, F.R.C.S.

THE problem of the fractured femur is the problem of the stiff knee. The fracture itself presents little difficulty, with the exception of those fractures occurring in the supracondylar region, and the upper third of the shaft of the femur. In war time, the problem of the stiff knee is of the utmost importance. A soldier who has had a fracture of the femur is unlikely to return to duty, not because of the mal-union or non-union of the fracture, but because of the disability resulting from the stiffness of the knee-joint.

For most occupations the industrial worker requires a range of at least 90 degrees, and for some he requires a range considerably greater than this in order to do work Much time has therefore to be spent on treatment directed towards

unstiffening the knee long after the fracture has healed.

The three main factors in the production of the stiff knee are disuse, immobilization, and sepsis. Immobilization of the knee-joint and sepsis may be unavoidable, particularly in certain severe open fractures with loss of bone substance. But in our experience disuse is the commonest and most important cause, and the one most easily prevented. Unless movement of the knee is begun early, within the first six weeks, such stiffness will result that a full range of movement is unlikely ever to be regained, and a useful range will only be obtained after many months of strenuous treatment.

In brief, the method we use is as follows: That part of the sectional mattress of the Pearson bed under the leg is removed. The slings supporting the leg below the knee are then removed. The leg is counterpoised by a weight of about 2 lb, suspended by a sling passing under the leg just above the ankle. The patient then actively bends the knee against the resistance of the counterpoising weight.

Previously, flexion of the knee was obtained by the use of the hip flexors and the aid of gravity. By the present method, however, flexion is obtained by an active contraction of the hamstrings. This automatically produces an active relaxation of the quadriceps, and a greater range of movement is possible. The patient performs these exercises twice a day in addition to quadriceps drill and other exercises to the leg, which are

carried out at least three times a day.

We have been able to analyse the results obtained in 34 patients with fractures of the femur. 18 patients were treated by early knee movement, and 16 without early knee movement. Of the 18 patients treated with early knee movement, 5 had transtrochanteric fractures, and an average of 12 degrees of knee flexion at three months; 9 had fractures of the shaft and an average of 90 degrees of knee flexion at 61/2 months; 4 had T-shaped fractures into the knee-joint and an average of 115 degrees of knee flexion at 6 months. In sharp contrast, the 16 patients treated without early knee movement, had an average of 35 degrees of knee flexion at 12 months.

A further analysis of the results of early knee movement showed that, if about 35 degrees of knee flexion could be obtained in the first six weeks, subsequent immobilization of the knee by means of a caliper or a plaster spica did not prevent the early return of normal movement. Moreover, normal movement was regained by exercises without

the employment of manipulation under anæsthetic, or forcing passive movement.

The treatment of the established stiff knee by exercises, faradism and manipulation under anæsthetic has proved disappointing in our hands. One of the reasons for this is the contracture of the quadriceps muscle. Manipulation, since it is the application of a sudden force, cannot overcome this. Excision of the patella is obviously unsound and will inevitably fail. We have endeavoured to overcome quadriceps shortening by forced passive stretching without anæsthesia, using the application of a large force over a long period of time. The method we use is as follows: The patient lies face downwards on a table or suitable couch. A halter is then passed round the leg just above the ankle, and traction is maintained by a system of pulleys at right angles to the leg. A weight greater than the quadriceps can counteract is used—usually 20-35 lb., and the pull maintained for about fifteen minutes at a time.

We have been able to compare the results of treatment of the established stiff knee in 13 patients. Five patients were treated by faradism, exercises and manipulation under anæsthesia. Eight patients were treated in the same way, with the addition of a forced passive stretching. In the first group, two patients obtained a range of 45 degrees at 18 and 16 months respectively; two a range of 30 degrees at 13 and 10 months; one a range of 10 degrees at 26 months. In the second group, two obtained a full range at 10 and 12 months; one a range of 110 degrees at 18 months; three a range of 90 degrees at 16, 10 and 9 months respectively; two others obtained a range of 45 degrees and 30 degrees at 20 and 12 months respectively and are still under treatment.

Four cases illustrating the main points were demonstrated,

# Section of Radiology

President-M. H. JUPE, D.M.R.E.

[June 19, 1942]

#### DISCUSSION ON THE EFFECTS OF OCCUPATIONAL EXPOSURE TO X-RAYS AND RADIOACTIVE SUBSTANCES

Dr. John R. Nuttall (abridged): The development of the use of X-rays and radioactive substances in industry and medicine was accompanied by tragic loss of health and of life. As a result of much careful investigation the International Protection Committee has improved working conditions in the medical field so that workers to-day enjoy a high

degree of safety.

Unfortunately, since the outbreak of the present war, evidence has been accumulating that the stage is set for a re-enactment of the tragedies of the pioneer period. X-ray apparatus and luminous paint are again being used in industry. In medical practice there has been wide distribution of portable X-ray diagnostic plants and radiotherapy is being done in small temporary units where the staff is continuously too near the sources of radiation. We should therefore review our knowledge of the dangers, and should consider the means of combating them.

Serious upset of health may arise from the local effects of radiation upon the skin and upon the blood, and also from the ingestion of radioactive substances into the alimentary tract, the inspiration of radon, and damage to the reproductive organs. By far the most

important are the blood changes.

Ingestion is unlikely in hospital work because radium there is in sealed containers. It may occur, however, if instruments contaminated with radon are introduced into the

Inspiration of radon does not appear to present a problem in hospital.

With reasonable care there is no danger of sterility. Menstruation is unaffected. Probably radiation work should be avoided in early pregnancy. On cessation of exposure early reactions of the skin recover but late skin effects remain and may lead to epithelioma.

I should like to mention an observation I have not seen described—the curious phenomenon of acute radiation tiredness. Briefly, after a day's work, normal in ordinary physical and mental effort but during which there has been comparatively large exposure to radiation, the worker complains of undue physical and mental fatigue and irritability. The development of unexpected fatigue is considered in the Manchester Radium Institute to indicate that too much radiation has been received and to call for investigation of exposure. My impression, however, is that it is not constant in all workers, and that it is modified by conditions of temperature and ventilation in the work-rooms.

D. R. Goodfellow has shown that there is only one sign of early over-exposure which is common to all individuals. This is an absolute and progressive leukopenia due to neutropenia, which, if unchecked, will reach a dangerously low level. Individuals vary in their susceptibility to radiation, the more sensitive ones exhibiting absolute lymphocytosis

together with absolute neutropenia. In severe cases the curves may intersect.

The old Manchester Radium Institute was small and badly protected, there were several cases of skin damage, and at least one member of the medical staff abandoned radium work with serious blood changes showing the prodromal signs of aplastic anæmia. The average total W.B.C. count of all workers fell to 4,300 with individual low counts of 3,000. Minor infections were frequent and several workers required leave of absence on account of their blood condition. In 1933 the Institute moved to new quarters in which the protection was tested and found to be efficient. Within six months the average total W.B.C. count had risen to 5,500. A rising number of patients involved more treatments being carried out by each member of the staff, and two years later the average total W.B.C. count was 4,400. Additions to staff and re-organization of duties were followed by a rapid rise to an average W.B.C. count of 6,000. At this level it has

This history is instructive. That lack of protection is followed by serious damage to health is a long-established fact, but that "efficient" protection is not sufficient is perhaps less widely appreciated. The policy of short-term service in radiation work is widely employed, but is only applicable to semi-technical workers and nursing staff. Rotation of duties so that an individual is exposed to radiation for a few weeks at a time, alternating

this with some safe duty, may be applied more widely. Coupled with rotation is the conception of dilution of the exposure by spreading the work amongst a large staff, and it is my impression that rotation and dilution are of just as great importance as distance and lead shields. Whilst considering dilution it is interesting to observe that when each doctor was carrying out an average of six radium treatments involving exposure per week the white cell counts were bad. When additions to staff lowered the average weekly treatments to four and a half the average total W.B.C. count rose to 6,000.

This level of about 6,000 W.B.C. is important. Although it is lower than the usually accepted normal (and certainly represents an initial drop in individuals after employment) it does seem to be unattended by ill-effects, to be capable of maintenance while an average amount of work is being done and not to be accompanied by susceptibility to minor

infections

Workers in the X-ray therapy department using completely protected tubes operating at 240 kv. and in the diagnostic department have shown no particular blood changes as a result of their employment. Their working hours, and the protection of the plant con-

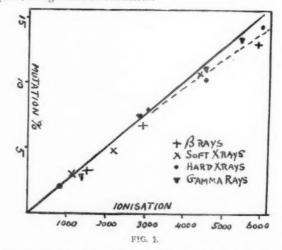
form fully with the Protection Committee's Regulations.

It is obvious that modern technical improvements have made it possible for X-ray work to be safe for all except the culpably careless. It is difficult to see how further technical developments alone can perform a similar service for radium workers other than those engaged in beam therapy. There is room for further regulations with regard to the clinical use of radium, taking into account the finding that up to a point there is comparative safety, but that very little increase in exposure beyond that point is followed by definite leukopenia. In the staffing of new, or enlarged, departments under the Cancer Bill the value of dilution must be taken into account if other centres are not to experience the dangers which befell the Manchester Radium Institute during the period of rapid growth following its removal to new, and apparently ideal, quarters.

**Dr. J. C. Mottram**: Mutations produced by radiation in relation to mankind.—Radiation changes the hereditary function of cells in two ways, by causing chromosomal aberrations and by producing gene mutations. In considering action on men and women, both these should be taken into account, especially as there is some overlap; for instance, small deletions of chromosomes are difficult to distinguish from gene mutations.

Gene mutations were known long before it was discovered by Muller that X-rays produce mutations. They occur spontaneously, their cause being unknown; further, mutations produced by X-rays do not differ in any way from spontaneous mutations. The vast majority of mutations of radiation were previously known. The common spontaneous mutations are commonly produced by radiation, and the uncommon ones rarely. It is indeed a fair statement to make that radiations do no more than greatly increase the incidence of spontaneous mutations.

In the first place, dosage must be considered.



Here is seen a linear relationship between ionization and mutation percentage. This is quite different from most biological effects of radiation, such as erythema where a considerable dose is required before any effect is produced. Here the smallest dose will produce

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a mutation if, by chance, a cluster of ions is released in a gene. This is important; it means that one can only escape this effect by complete protection from radiation.

We are really concerned with the lowest part of this chart where there are no readings; it has, however, been established that the linear relation extends down to very small doses; there is some falling off from the linear relation at high doses because some clusters of ions will wastefully produce two lethal mutations in the same chromosome.

The chart also shows that there is no wave-length dependence: soft X-rays and gamma rays are equally efficient.

		TABLE I.		
Mg. Ra.	Hours expos.	r units	Chromo- somes	mutations
300 4 2	37 <sup>1</sup> / <sub>2</sub> 75	6315 6315 6315	637 636 626	4·71 4·71 4·57
300 4 2 4	1 75 150 150	12630 12631 12627 25263	626 622 619 366	9·74 9·64 9·53 20·22

Since the relationship is linear and independent of wave-length, it would be expected that there would also be no dependence on intensity. Table I shows this to be the case. It follows that one cannot escape this effect of radiation by keeping the intensity very low. Therefore persons exposed to radiation will show in their descendants, on an average, more mutations than normal persons; they can keep this effect low by protection, but only by complete protection can they entirely eliminate it.

It has been calculated by Pickhan that if the spontaneous rate were due to radiation, a dose of 10-12 r would be required; the spontaneous rate for the fruit fly has been found to be from 1-3 mutations per 100 ova or sperm. It will probably be a little higher in man as there are more genes at stake, so I am taking the figure 3%.

If 10-12 r represents the spontaneous rate, it is obvious the X-ray photography where the ovary might receive 2 r, is of no importance. In screen examinations, the ovary might get 30 r, which would about double the spontaneous mutation rate. It will be seen later that this too is of little importance. The dose required to produce temporary sterilization is about 300 r; this would raise the mutations to 33 per 100 ova or sperm, a limit which, as will be seen, is to be avoided.

Occasionally in treatment the ovaries will receive larger doses, in which case the patient should be warned of the danger to subsequent children. About 1,000 r causes permanent sterility

For properly protected radium and X-ray workers the dose is small, 1-2 r per week, but this will accumulate to, say, 100 r per year, and 300 r in three years. The life period of sperm is short and a dangerous dose will not accumulate, but this is not the case for overwhere a dose of 300 r in three years would, in my opinion, be undesirable. Perhaps there is not this difference since spermatogonia are long-lived.

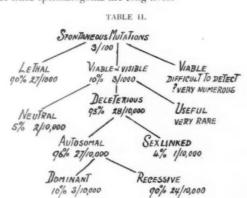


Table II deals with mutations in detail; they are divided into lethal and viable. Some of the viable are visible and easy to detect, but an unknown number are small and difficult to recognize. The figures in the table indicate only approximately the percentages.

Lethal mutations form about 90% of the spontaneous, and will also form 90% of those due to radiation. They will be either dominant or recessive. If dominant, it would only mean, for the person exposed to radiation, that occasionally an embryo would die in early pregnancy; there would still be plenty of normal ova and sperm to make use of. If recessive, the same would hold for some of the radiated person's descendants; how distant, I shall indicate (see deleterious recessives). Lethal mutations are therefore of very little importance.

Turning to viable mutations, it is seen that some are neutral, 5%, a very few useful and the vast majority, 95%, deleterious. The useful and the neutral do not, of course, concern us. The deleterious mutations are divided into sex-linked 4% and autosomal 96% (i.e. pertaining to all chromosomes other than the sex chromosomes).

The autosomal are again divided into dominant and recessive. Now, from the point of view of a radiated person, these dominant deleterious mutations are important, as they will appear in his children and half the children of an affected child and so on. Likewise the sex-linked mutations will appear in the sons of his daughters, in all, about 4 per 10,000 eggs or sperm for the spontaneous rate; this would be raised to 44 per 10,000 by an exposure of 300 r. I do not think the risk of having one child in 230 bearing a deleterious trait to pass on to descendants should be disregarded from the point of view of the children of radiated persons or of the human race. It is, however, a matter of opinion. The spontaneous rate is 1:2,700.

As regards recessive deleterious mutations, these are much more numerous but will not appear in the children of the radiated person, only in his descendants, and only occasionally in his near descendants, should cousins or other pear relatives marry. Muller has calculated that in man, the average time before a new recessive gene would meet a like one and thus manifest itself would be from 750-3,000 years. These figures become 5,000 years for a mutated gene to meet another descended from the original mutated gene. I think that these figures for recessives show that we need not take them into account.

Turning lastly to the small viable mutations: little is known of these, probably they are very numerous, playing an important part in general health, susceptibility to disease, mental well-being, &c. It is known that all living processes are under the influence of heredity as well as of environment; it may be that further knowledge here will necessitate a reconsideration of radiation from that point of view.

In conclusion, it is my opinion that a few hundred r to ova or sperm is a risk to be avoided from the point of view of producing dominant deleterious mutations. I draw attention to the fact that female radium and X-ray workers can easily accumulate such a dose over a number of years.

Professor Sidney Russ restricted his remarks to the harmful effects of radioactive substances. It seemed that the chief dangers in handling arose in chemical and technical work; the danger to people using radium in medical work was avoidable by the practical adoption of straightforward rules of safety. But this was a much more difficult matter when one had to deal with the naked salts of radium; here the chemist had occasionally to run risks, glass tubes containing two to three hundred milligrams of mature radium salts had to be opened and the contents put into solution. A meticulous regard to personal safety should be supported by a working policy which forbade such mass operations to be performed at all frequently by the same person.

The technical operations with radium were mainly those in which the radium salt was mixed with a fluorescent substance and used as an illuminating paint. The operatives, known as luminisers, had received special consideration for their safety. An Order (1942) called the Factories (Luminising, "Health and Safety Provisions") Order had recently come into force. Provided the management at a factory made it their business to see that the excellent provisions for safety in this Order were carried out, there need be little fear of damage to the health of their employees. Even so, in most cases the air in a radioactive laboratory or workshop would contain radon, the occupants would breathe it and during the working day their atmosphere would be a very slightly radioactive one. Some recent measurements proved that an operative under these conditions showed measurable radon in the expired air. Controls upon the workshop air showed less than this amount, and the question arose, whether the radon in the expired air was due to radium in the operative concerned. This was a grave issue, and it showed the need for great care in recommendations about the limits of safety. It might be necessary to suggest one limit for radon in the

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air and a different limit for the amount of radium in the body which we might have to tolerate—everyone may have some, bearing in mind the ubiquitous character of this very rare substance, so this should prevent fantastic limits being put forward.

What was the threshold of safety of radon in the air? Professor Russ quoted two medical opinions which had been expressed about these safety limits. The first was a recent private communication from the States: "Medical research workers have determined that a tolerance dosage of radium has been received when a breath sample from the exposed person contains 10-11 curie per litre of air." The second was in a paper by Read and Mottram (Brit. J. Radiol., 1939, 12, 54): "... the tolerance concentration (of radon) would seem to be about 10-11 curie/c.c." Note that one is a thousandfold the other. One referred to the safety limit of the amount of radium in the body, the other to the concentration of radon that can be safely tolerated in the atmosphere. Professor Russ gave a detailed criticism of the latter, and concluded that for safety it should be recommended that a concentration of radon of 10-10 curie per litre in the air for operatives should not be exceeded.

The "tolerance dosage of radium" ("quantity" seemed a better word) was a difficult matter. If we found the suggested safety limit of radon per litre in the expired air (i.e., 10-10 curie) and we could prove that this radon was due to radium in the body, then what was this quantity of radium? To deduce this we required to know what percentage of the the radon produced per second by such radium was to be found in the expired air. Estimations of this percentage inevitably varied. Read gave the figure 50% for radium which had been recently ingested. Evans had proved a range decreasing from 40% to 2% as the time the radium has been in the body increases. If we took Read's figure for the one type of case and 10% for the other, calculation showed that the quantity of radium in the body would range from 4 to 80 micrograms. These figures at once suggested that, if 10-10 curie per litre in the expired air was found by separate tests to be due to the presence of radium in the body, then the operative should be taken off all radioactive work.

If a recommendation were framed in this way we were not committing ourselves to a radium figure that we had no accurate means of estimating, with the advantage that the same figure, viz. 10-10 curie per litre of expired air, might serve as a danger signal for an atmosphere of radon and as a much more dangerous sign of a deposit of radium in the body.

Additional data were given about the concentrations of radium and radon occurring in Nature.

Dr. Janet M. Vaughan: The effect of occupational exposure to X-rays and radioactive substances upon hæmopoiesis (Abridged).—First, it is necessary to distinguish between the two substances, since radium is more likely to be dangerous on account of the greater penetrating power of the rays. Past records are difficult to interpret, because the distinction is rarely made. Secondly, the possible effect of defective hygienic surroundings other than rays must be taken into account. Thirdly, it is essential to have records of the blood-count in workers before they take up X-ray or radium work, as anæmia may be due to other causes.

Review of the available evidence suggests that external radiations from X-ray or radium are without effect on the red cells or hæmoglobin of workers starting with a healthy blood picture (Aubertin, 1912; Pfahler, 1922; Portis, 1925; Lavedan, 1927; Mottram, 1932; Kaplan and Rubenfeld, 1936; Whitby, 1936. See Table I). It appears also, that provided reasonable precautions are taken, X-rays and probably external radiation with radium are without effect upon the white cell count, provided the worker has a normal count in the first instance (Pfahler, 1922; Portis, 1925; Lavedan, 1927; Kaplan and Rubenfeld, 1936; Whitby, 1936). Certain workers have described an increase in eosinophils and sometimes of monocytes, associated with a leucopenia due to a decrease in polymorphs. (Table II.)

TABLE I.-EFFECT OF X-RAYS UPON RED CELLS AND HÆMOGLOBIN.

Author							Effects observed
AUBERTIN	***	***	***	***	***	***	no effect
GUDZENT	AND	HALB	ERST	AEDT	ER	***	decrease
PEAHLER							(2) no effect no effect
PORTIS	***	***	***	***	***	***	no effect
	***	***	***	***	***	***	(1) increase (2) no effect
MOTTRAM	***	***	***	* * *		***	(1) increase (2) decrease
							(3) no effect
				***	***	4 4 9	no effect
	AUBERTIN BÉCLERE GUDZENT PFAHLER PORTIS LAVEDAN MOTTRAM	AUBERTIN BÉCLERE GUDZENT AND PFAHLER PORTIS LAVEDAN MOTTRAM KAPLAN AND B	AUBERTIN BÊCLERE GUDZENT AND HALB PFAHLER PORTIS LAVEDAN MOTTRAM KAPLAN AND RUBEN WHITEV	AUBERTIN BECLERE GUDZENT AND HALBERSTA PFAHLER PORTIS	AUBERTIN BECLERE GUDZENT AND HALBERSTAEDT PFAHLER PORTIS	AUBERTIN BECLERE GUDZENT AND HALBERSTAEDTER PFAHLER PORTIS	AUBERTIN BÉCLERE GUDZENT AND HALBERSTAEDTER  PFAHLER PORTIS. LAVEDAN  MOTTRAM  KAPLAN AND RUBENFELD

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#### TABLE II.-EFFECT OF X-RAYS AND RADIUM UPON LEUCOCYTES.

Date							Eff	ects observed or	n	
	Author					Total	Eosinophils	Polymorphs	Lymphocytes	Monocytes
1912	AUBERTIN					(1) increase	increase	increase		
1912 1914	BÉCLÈRE GUDZENT &	k HALB	ERST.	AEDT	TER	(2) decrease decrease	increase	decrease decrease		increase increase increase
1919 1922	RUSS PFAHLER	***	• • •	***	***	decrease	increase	decrease	decrease relative increase	
1925	PORTIS		***	***	***	decrease		decrease	relative increase	
1927 1936	LAVEDAN KAPLAN &	RUBENI	FELD	***	•••	decrease decrease	increase	decrease decrease	relative	increase
1936	WHITBY					decrease		decrease	increase	

Internal radiation with radioactive substances, however, presents a severe industrial hazard and is of particular importance in war time, when the use of instruments with luminous dials is common. Such radioactive substances may be either ingested, as when painters lick their brushes (Martland, 1931; Rajensky, 1939), or inhaled in the form of dust or emanation. The former is more common. Radioactive substances are then absorbed from the intestine and deposited to a large extent in the bones, where they continue to emit alpha rays described by Martland (1931) as "the most potent and destructive agent known to science". The presence of as little as a microgram (Rajensky, 1939) may result in a severe and fatal anæmia. This anæmia, with one doubtful exception, is megalocytic and hyperchromic in type (Martland, 1931). At autopsy, an active regenerating marrow similar to that found in Addisonian pernicious anæmia is present. Certain cases have developed fatal symptoms six to eight years after their last exposure. In this late form death is usually due to sarcoma of the bones, but anæmia may be present and is then of the same megalocytic hyperchromic type.

In order to protect workers handling luminizing paint, a new order has just been introduced called the Factories (Luminising, "Health and Safety Provisions") Order.

Deaths from anæmia following inhalation of radioactive substances have been recorded (Martland, 1931), but are not as common as those following ingestion.

The question of the occurrence of leukæmia in X-ray and radium workers has been much discussed (Nielson, 1932; Rolleston, 1930; Colwell and Russ, 1934; Maingot, Girard and Bousser, 1938; Weitz, 1938). Both myeloid and lymphatic leukæmia are said to have occurred in X-ray and radium workers as the result of their occupation. When the large number of such workers is remembered, the evidence that rays were responsible for the blood dyscrasia is not altogether convincing. It has been possible to trace less than twenty such cases with adequate records.

It is therefore concluded: (1) External radiations from X-ray or radium do not represent an occupational hazard to workers starting with a normal blood picture provided normal and adequate protective precautions are observed. (2) Severe and fatal blood dyscrasias may result from handling radioactive substances, the most common being a megalocytic hyperchromic type of anæmia, dependent upon internal radiation by alpha particles following ingestion by mouth. (3) Individual idiosyncrasy is probably of some importance in the development of blood changes, following exposure to X-ray and radioactive substances, as it is with other occupational blood dyscrasias.

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## Section of Psychiatry

President-A. A. W. PETRIE, M.D., F.R.C.P.

[February 18, 1942]

# DISCUSSION ON THE ASSESSMENT OF CRIMINAL RESPONSIBILITY IN THE ARMED FORCES

Lieut.-Col. T. M. Backhouse: The question of the mental responsibility of any person who is accused of a crime is a question of fact to be decided neither by doctor nor lawyer but to be decided, as every other question of fact in a criminal court, by a jury of nonexperts representing the ordinary opinion of the country and coming to their decision with such assistance as they may be able to obtain from the medical specialist on the one hand and the legal specialist on the other. Thus, the medical witness may give the greatest assistance to the jury by offering them what is his expert opinion as to the probable state of the person accused at the time he did the act of which he is accused, but still the jury have to find the facts. Equally, the lawyer, in the person of the Judge, Prosecutor, or Defending Counsel, will tell the jury what is the abstract law and assist the jury in applying the law to the concrete facts of the case they are trying, but it remains the responsibility of the jury to decide the question of fact as to whether or not the accused should be held responsible to the State for his action, bearing in mind in reaching their conclusion both the medical evidence which they have heard and the direction on law which they have heard. Any departure from this principle would strike at the very foundation of English Criminal Law.

Shortly, once a person is alleged to have committed a crime the law insists that it is a matter for organized society, in the form of a court, to decide what steps are necessary to protect society, whether the alleged offender be mentally affected or not, and that this

cannot be left to the medical practitioner or the lawyer alone.

In civil courts the position is clearly defined and may be taken to be understood by the professional lawyer who guides or assists the court, but considerable difficulties have been encountered by military courts, which usually have no special legal knowledge nor the assistance of a lawyer, in deciding how to reconcile the medical views with the legal. In the civil courts if a person is accused of a crime, after a preliminary investigation by a magistrate he is then committed for trial and tried, if at all, either by a court of quarter sessions or an assize court, either of which would be presided over by a very experienced lawyer who would direct the court on law and in each of which the decisions are made by a jury; and from these courts there is an appeal to the court of criminal appeal. Army procedure differs in a number of ways. If a soldier is accused of an offence there is a preliminary investigation by his commanding officer and a summary of evidence, which corresponds to the depositions in a civil court, is taken. If the commanding officer decides that there is a case to be tried he remands the soldier for trial by court-martial and forwards the charge, together with the summary of evidence, to a senior officer, usually his Brigade Commander, who then decides whether or not he will convene a court to try the soldier. If he decides that the soldier should be tried, he then convenes a court-martial for the trial. In the great majority of cases this court will be composed of three regimental officers with no legal experience and with no legal assistance and this court sits both as judge and as jury. The decisions of this court, however—unless they find the accused not guilty-have no legal effect until they have been considered by a confirming officer, who is normally the same person as the convening officer, and he can refuse confirmation—which would act as an acquittal—or he can reduce any sentence, or remit it altogether, and he can if he so wishes direct that the sentence shall not begin to operate until it has been reviewed again by a superior military authority. After the confirming officer has dealt with the case the proceedings are then reviewed for the first time by a lawyer, a member of the Judge Advocate General's Department, who will advise the superior military authority to whom the proceedings are next referred, on any legal point which may arise, and the superior military authority, usually a Divisional or Corps Commander, may quash the finding of guilty if he thinks fit, or may remit or reduce any sentence or may suspend the sentence. The proceedings are again reviewed by the Judge Advocate General when they reach the War Office for final disposal.

Every person accused of a crime is presumed by law to be sane and legally responsible

for his actions until the contrary is proved by evidence, but the law recognizes three classes of persons as not mentally normal, and each class is carefully defined and in the civil courts a procedure is laid down for their discovery and treatment. All other persons are treated as being fully responsible to society for their actions. The classification is:

(a) Persons unfit to stand trial owing to their being found to be insane after their committal for trial or at the time of their trial. (b) Persons who are insane at the time of the commission of the alleged offence. (c) Mental defectives within the meaning of the

Mental Deficiency Acts.

Persons unfit to stand trial owing to mental disability may be subdivided into: (i) Persons committed for trial who before they can be tried are certified to be insane. The Criminal Lunatics Acts, 1884, empower the Secretary of State to remove such person to a lunatic asylum and detain him as a criminal lunatic until he is either committed to prison or discharged. (ii) Persons brought before a court and before any plea is recorded found to be insane by a jury empanelled for the purpose. The issue which the jury is directed to try is as follows: "whether the person is of sufficient intellect to comprehend the course of the proceedings of the trial so as to make a proper defence and challenge a juror to whom he might wish to object and to understand the details of the evidence." In the event of the accused being so found he is in fact treated as a criminal lunatic and the trial of course does not proceed.

Persons found to be insane at the time of the commission of the alleged offence.—If a person is found to be fit to plead the trial will proceed normally but the defence can raise the issue that the accused, although he committed the act or omission constituting the offence, was insane so as not to be responsible according to law for his actions at the time. In this case: "the jury ought to be told that every man is presumed to be sane and responsible for his crimes until the contrary be proved to their satisfaction, and that to establish a defence on the grounds of insanity it must be clearly proved that at the time of the commission of the act the party accused was labouring under such defect of reason from disease of the mind as not to know the nature and quality of the act he was doing or if he did know it that he did not know he was doing what was

wrong.

If the jury accept this view they will return a special verdict to the effect that the accused is guilty of the act or omission charged against him but was insane at the time when he did the act or made the omission, and the court will order the accused to be kept in custody as a criminal lunatic until His Majesty's pleasure shall be known.

Mental defectives.—The legal definition of a mental defective is contained in the Mental Deficiency Acts and includes idiots, imbeciles, feeble-minded persons and moral defectives. For the purpose of the above definition mental defectiveness means a condition of arrested or incomplete development of mind, existing before the age of 18 years,

whether arising from inherent causes or induced by disease or injury.

Mental deficiency not amounting to legal insanity is not regarded as an excuse for crime but only as a matter to be considered in the question of the subsequent treatment of an offender after he has been found guilty. A mental defective is tried in the same way as any other prisoner but if the court before whom any person is charged with a criminal offence punishable, in the case of an adult, with penal servitude or imprisonment, is satisfied on medical evidence that he is defective within the meaning of the Act, the court may either postpone passing sentence and direct that a petition be presented under the Act, or, in lieu of passing sentence, itself make an order committing the accused person to an institution for defectives or to be placed under the guardianship of some person. A duty is placed on the prosecution to bring before the court such evidence as to an accused person's mental condition as may be available if it appears to them that any person charged with an offence is a defective.

Where the greatest difficulty arises, I think, is in the difference of the meaning of mental defective to a lawyer and to a psychiatrist. I have argued this question with several psychiatrists, and am satisfied that it is the different usage of this phrase that leads to the greatest confusion. To a lawyer there are only three classes of persons, sane, mental defective and insane, and if a mental defective in the medical sense is so defective as to fall within the legal definition of insanity, to a lawyer he ceases to be a mental defective although to a doctor he remains one. This has led to endless argument but I think that if it is once realized that to a lawyer a mental defective simply means a person who falls within the definition of mental defective contained in the Mental Deficiency Acts, and who is not so defective as to fall within the classification of insanity, the position becomes clear, and during the rest of this paper I use the phrase "mental"

defective" purely in its legal sense.

To a certain extent the considerations affecting the decisions as to whether a person should or should not be tried by court-martial are dissimilar from those to be considered

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in deciding whether a civilian should be tried before the civil courts. A military court is concerned with the maintenance of military discipline and a military convening officer is entitled to take into account many questions of convenience, expedience and expense which are not the concern of the civil authorities under similar circumstances, and to say, if he considers that it is unnecessary for the purpose of military discipline, that he will not waste the time of military personnel in trying a soldier even though he be guilty of a civil offence.

Military procedure in respect of persons unfit to plead or insane at the time of the commission of the offence is precisely similar to civil procedure. Mental defectives, however, are not dealt with at all under either the Army Act or the Rules of Procedure, but as I have already explained there are two further stages in military procedure which are missing in civil procedure, namely, confirmation and review with the powers of remission and suspension inherent therein and of course the final power of discharge from the Army.

It will be seen from the above that in law only insanity is the concern of the court before the question of guilt is determined. Mental deficiency is never a defence but merely a matter to be taken into account in deciding on the treatment of a delinquent after conviction. The following principles therefore follow: (i) Both insanity and mental deficiency are matters which concern the convening officer when deciding whether or not to convene a court-martial. (ii) Insanity only and not mental deficiency concerns the court when deciding whether a soldier is fit to stand his trial; (iii) Insanity only concerns the court prior to a finding of guilty; (iv) Mental deficiency may concern the court, subject to what is suggested hereafter, when determining the sentence of the court; (v) Mental deficiency is always the concern of the confirming officer when considering the subsequent treatment of a soldier found guilty by court-martial.

A recent Army Council Instruction lays down that the unit medical officer must give a certificate as to both the physical condition of the soldier and also his mental condition before application for trial is made, and if either he or the soldier's commanding officer considers that the soldier's mental condition should be investigated, he will obtain a psychiatrist's report. The psychiatrist's report goes to the convening officer with the application for trial, and in this report is set out the answers to a series of questions giving his definite opinion as to whether a soldier is fit to plead within the meaning of the legal definition, whether he was, in his opinion, at the time of the commission of the act insane within the definition laid down in the McNaughton Rules, and further, even though he thinks he is both fit for trial and sane at the time of the commission of the offence, his views on his general mental condition, and the effect which might be expected to result from trial and/or punishment, and lastly his fitness to continue to serve in the Army.

If there is any suggestion that the soldier is insane or mentally defective, the case together with the report is submitted to an officer of the Judge Advocate General's Department, and after receiving his advice the convening officer can then decide whether in the light of the information disclosed in the report it is in his view necessary for the purpose of discipline to convene a court-martial. If a soldier is reported to be insane, plainly no court-martial would be convened until he had been before a medical board, and the question of his insanity decided by the board. If he is reported to be mentally defective it would then be a matter for the convening officer to decide whether to apply for his discharge under the provisions of King's Regulations 390 or whether it is desirable that he should be tried and the question of discharge considered at a later stage.

If trial is once ordered by the convening officer and at the trial either the prosecutor or the defending officer raises the issue that the accused is unfit to plead, evidence is called and the court hears and decides the issue on the evidence brought before it and it should not accept reports or other inadmissible evidence.

If the defending officer raises the issue of insanity at the time of the commission of the offence the court should proceed strictly on the evidence and should not accept any medical reports or other documents inadmissible in evidence, bearing in mind that it is for the defence to prove the insanity.

In the event of a finding of guilty the court should accept, if the defence wish to put it forward, any evidence of mental deficiency and for this purpose they may properly accept a report from a psychiatrist de bene esse and take this evidence into consideration together with other factors in deciding upon their sentence.

When the proceedings are forwarded to the confirming officer, this officer then considers, taking into account the medical reports before him, whether or not he should recommend a suspension of the sentence pending an application for the accused's discharge, or whether he should allow the soldier to proceed to the detention barracks in the ordinary way, drawing the attention of the commandant to the soldier's mental condition in accordance with King's Regulations 691 (c) and notifying this

action in the covering minute attached to the proceedings in accordance with King's

Regulations 702.

The whole essence of the procedure is to ensure as far as possible (a) that the question of a soldier's fitness for trial is decided by the convening officer with the assistance of the psychiatric specialist and the legal specialist before the court is convened at all; (b) that the question of the soldier's responsibility for the crime is tried on proper evidence at the trial and that only genuine legal insanity is allowed to interfere with a finding of guilty or not guilty; (c) that any question of mental irresponsibility short of legal insanity is properly considered not in the atmosphere of a court-martial but after the trial by the confirming officer again with the assistance of the legal and psychiatric specialists before the soldier in fact receives any punishment.

Another problem is the question of the disposal of a mentally defective soldier who is not certifiably insane. At present he is merely discharged from the Army and left to his own devices, and as often as not re-enlists. I understand that conversations are taking place between the War Office and the Home Office or the Board of Control to

deal with this aspect of the problem.

Lawyers have always been ready and willing to have a revision of the McNaughton Rules, and it is the medical profession who has failed to agree upon any new definition. In practice the present definition appears to work very well, and it is left in every case in civil law to a jury of ordinary men, in military law to a court of ordinary military officers, to apply their common sense to the problem of responsibility. In my own experience it is seldom that a man who is really not responsible for his actions is convicted of any offence and indeed it is much more often that a man who is really responsible escapes.

Surgeon Lieutenant-Commander E. W. Anderson, R.N.V.R.: The assessment of responsibility in naval offenders.—As psychiatrist to a Royal Naval Barracks it has been my duty for the past year to examine all offenders where doubt exists that the individual was not responsible for his offence in virtue of mental abnormality. Sometimes this disorder is so apparent that the case is referred by the authorities before disciplinary action is taken, in others the plea of mental disorder is raised by the individual himself when charged. In the latter case the man is informed that he may have the benefit of a psychiatric opinion. In some cases the plea is, often obviously, a mere pretext and the alternative of a period in cells is preferred to exposure as a humbug and the possible gibes of his mates. Optimism, however, is a striking characteristic of the naval rating and a number of bogus cases reach me in the hope that punishment may at least be mitigated. The psychiatrist has no harder task, nor any greater responsibility than the assessment of the imputability of offenders whether Service or civilian. The degree of care and thoroughness must be as great in each. There are, however, certain circumstances which would appear to modify the doctor's attitude to the Service case, an attitude which may again be slightly modified according to whether the offence occurs in peace or in war. Many civilian practitioners called up for service especially those accustomed to private practice, do not appreciate that the only concern of the Service with regard to the medical treatment of an individual, is "can this man be made fit for service or not?". In the latter case he is of no further interest to the Service and must be invalided. In warfare, especially total warfare, this attitude is heavily underlined. Under present conditions, especially in the Services, the individual is of much less account than the community. That it is this doctrine we are supposed to be resisting with all our strength has been a frequently remarked paradox.

This position of the individual is of significance with reference to "Crime". We must be clear for practical purposes whether responsibility exists in a given case, or is diminished as the result of a morbid mental state. We are thus concerned with what is called psychological responsibility. Any definition of imputability, as Kinberg (1941) has recently pointed out in a distinguished analysis, is unsatisfactory. We are accordingly thrown back for guidance on a detailed and intimate knowledge of psychiatry. The greater our knowledge of psychiatry and psychopathology, and, one might add, the more we know of men and women, the more likely are we to give a correct judgment.

Certain differences in general between Service and civil crime must be considered. The former concerns as a rule offences which are on a different plane from many of those on which we are asked to advise in civil practice. Thus desertion is a very different matter from rape or crimes of violence. Desertion appears a technical offence and in peace time might seem to be entirely so, but since the function of a fighting service is the preparation for war, and the maintenance of a strict discipline is necessary to this end, desertion, even in peace time, cannot be regarded merely as a technical offence. Even in peace, the penalty must be severe, but in war, where the whole community is in danger it acquires a greater moral significance, both on account of its possibly graver consequences and because of the increased sensitiveness of public opinion towards any purposive hindrance

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to the war effort. In war, the orientation not merely of the executive, but also of the psychiatrist where crime is concerned, must be persistently towards the community and the individual's claims must be assessed in this light. In assessing the responsibility in the individual case, the corrigibility of the offender and the deterrence of others are questions which seem to have a sharper and more immediate significance than in civil practice. True, civil punishment has both a corrective and a deterrent function. It is, however, more general and abstract in its operation. In a ship or establishment, a number of men are grouped together in close contact and knit by firm discipline. If a man offends and is punished all the others will hear the details of the offence and the punishment awarded. Any laxity in dealing with offenders is likely to be followed by an increase in crime. Whether or not an individual punished for embezzlement in Plymouth will deter another about to attempt this in Aberdeen is doubtful. One offender punished for desertion in a ship may deter 50 others. In general, Service punishment would appear to be successful in its aims.

It is therefore essential that the psychiatrist should not create a breach in this system, that he should not form a weak link in the chain, in particular out of consideration for the welfare of the individual, as against the community. He must decide in any given case (1) whether, even if psychiatric disorder exists, punishment is likely to deter him from repeating the offence; (2) what the effect on general discipline is likely to be if this man escapes punishment; (3) is punishment likely to make his state worse and thus make him less likely to be an efficient rating, or will it have lasting evil consequences to himself? Clearly in the case of a self-reproachful depression the first requirement might be satisfied; the effect on general discipline of the punishment of an obviously sick man is likely, if anything, to be bad, and with regard to (3) it is at least not likely to improve his state. This is an extreme and absurd instance.

It is, however, otherwise with many psychopaths. Many of their mates regard them as responsible and failure to punish them would have in time an adverse effect on morale as well as bringing psychiatry into contempt and disrepute among all ranks. The psychiatrist in a barracks should enjoy widespread confidence, and his work should be free from the suspicion of sentimentality and hocus-pocus. Punishment in many of these cases is likely to succeed in the first aim, i.e. deterrence, and the individual's condition is not likely to be made worse by punishment. I am strongly of the opinion that, in the case of many hysterical offenders punishment should precede treatment. In this way, the ground is cleared for future therapy and one motive for the reaction

To some of us there appears to have been an unduly tolerant attitude to some forms of psychopathy in recent years, due perhaps to the flabby and uncritical acceptance at face value of certain psychopathological doctrines and perhaps also to a greater slackness in our moral fibre in the inter-war years. In psychotherapy the individual's comfort seems to be given more thought than that of his entourage which is often regarded with indifference. Thus it has been sought to take the "stigma" from hysteria. That this may be undesirable, for example, in certain cases of "effort syndrome" has been shown by Paul Wood (1941). The Service psychiatrist will do well to see to it that the way of the hysteric shall be hard and the profit be withdrawn from psychopathy. In one year 662 patients were seen in the Psychiatric Department. Of these, 56, or approximately 8-5% were offenders. The series included two officers. 76% of the offences concerned desertion and leave breaking. Six showed no psychiatric disorder.

Hysterical and affective reactions were associated with desertion more frequently than other forms, but the rather low incidence of hysterical states and reactions was surprising, for the hysterical deserter is usually regarded as the prototype of the psychopathic Service offender. Affective states were, however, actually as common. In 28 (50%) of the cases, no interference with punishment was recommended. In another 5 it was recommended that punishment might be modified.

A useful case, illustrating some points in the assessment of responsibility is that of a man, a supply P.O. aged 25, who was charged with having created a disturbance, and of having damaged certain property. The previous evening he had drunk 4 to 5 pints of beer between 5.30 and 10 p.m. It was stated that he had conversed normally at 10 p.m. He then went to the clothing store where he slept and after that did not remember anything of what happened. He said "my mind sort of went blank". He recalled that, soon afterwards, he had seen the damage he had done and remembered the escort arriving to take him to cells. He said "everything was quite ordinary afterwards". He understood perfectly what he had to do and say. He was not charged with drunkenness. He had no memory of the period between entering the store and seeing the damage he had done. He stated that the amount of alcohol was for him not excessive. He gave a history of one previous episode of violence after drinking during which he had

assaulted a policeman. The quantity of alcohol was said to have been greater on this occasion. As a child he had shown several psychopathic traits. His father had been a periodic drinker and his mother had had a depressive illness after his father's death. This man was recommended for invaliding which was carried out. It was considered that punishment in this case would have little deterrent effect since it was improbable he would abstain, and that having regard to his history and the likelihood of similar behaviour again perhaps after a small dose of alcohol, he was unlikely to be suitable for further service. The effect of his invaliding on morale was probably good, since the man was a senior rating and was deeply perturbed at the decision. His mates of equal seniority with good prospects in the Service probably also regarded the matter with concern. Also in view of the relatively small amount of alcohol taken and the unpredictability for him of its effects, he could not be regarded as responsible for having

offended through his own negligence.

The hysterical amnesic reactions as a rule, are of the thinnest, and it is usually possible, by the ordinary methods of the interview, to demonstrate in nearly all cases their partial character. This amnesia is of course a situational reaction and as such implies some degree of realization of wrongdoing. The patients very often remember a good deal of what they did during the alleged blank period. One's impression is that these amnesiæ are mostly more spurious than those met in civilian practice. They demonstrate, often nakedly, the shifting character of the boundary line between conscious deception, i.e. malingering, and deception which is less conscious, if this phrase may be permitted. This is most evident in hysterical pseudo-dementia. These individuals often show an extreme capacity for self-deception and considerably less for the deception of others. Such people are nearly always second-rate personalities, often of poor intelligence with unsatisfactory work records, a poor "health conscience", and a lifelong tendency to evasion, but who have, up to date, shown no psychopathic episodes. They are shiftless and take the short view. They readily fall to the temptation to quit. Desertion is for them the easiest of all offences. In civil life, if they have shirked their responsibilities, work or family, the penalty for them has often been not so severe or at least immediately not so painful. In short they have got away with it, at least for a time. Many first offenders in the Service, particularly new recruits, are unaware of the rigours of the punishment which awaits them for desertion. Some are, indeed, outraged at the use of the word to describe their absence. Many of these when punished receive for the first time in their lives an immediately unpleasant and uncomfortable award and because they are so egocentric and susceptible to such discomforts, the effect of punishment is at least well worth trying. The problem of the habitual offender is different. In many cases it was unfortunate that they should have been accepted for the Service. Being in, however, there was nothing else to be done. Invaliding was undesirable since this was often just what they wanted and would react unfavourably on morale. Other modes of getting rid of them were equally undesirable. The problem of disposal will be referred to later.

Hysterical pseudo-dementia in my experience is rare in civil life. In eleven years I remember seeing only 4 cases. I have occasionally seen in civil life delinquent mental defectives who showed a pseudo-demential colouring to their oligophrenia. During two years in the Navy I have seen at least twice as many cases. Two of these have been recorded elsewhere (Anderson, 1941; Anderson and Mallinson, 1941). Despite careful study of this reaction I have been unable to make any essentially new observations. Most of them correspond to the classical descriptions, e.g. that of Wernicke, and Stertz (1910). They have occurred in people of low intelligence and social level who in several cases gave a history of head injury. The theoretical problems raised by this reaction are important and fascinating, but it is with its practical and medico-legal aspects we are concerned here. I mentioned earlier that the estimation of the degree to which conscious participation enters into the genesis of these states was extremely difficult. It is practically impossible. One may think that this individual's reaction has more humbug about it than the other, but no more than that can be said. With most of them this element of humbug was strong. Most psychiatrists of experience would agree that feigned insanity is a rarity. I cannot recall ever having seen a case of pure simulation. Where the suspicion of I cannot recall ever having seen a case of pure simulation. simulation was strong I have never felt able to make a charge of malingering. This view has weighty support, e.g. by Kraepelin, Bleuler and Bumke. Bumke (1936) for example states: "The differentiation of psychogenic from exaggerated or pretended symptoms is fundamentally impossible." He goes on to say that the psychological mechanism involved in each is the same and further that even demonstrable simulation does not rule out hysteria. He admits that this conclusion involves a "painful renunciation". Bleuler (1937) states that those who simulate mental disorder are nearly all psychopaths and include some who actually are mentally disordered.

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I could give many examples of simulation which illustrate this. Bleuler also reminds us that the mere demonstration of simulation does not in itself indicate that the individual is sane or imputable. He again stresses the impossibility of drawing a dividing line between simulation and disease.

The mentally defective in the Navy form a small group. As to the question of responsibility it is altogether too simple to suppose that because an individual has a mental age of less than 10, i.e. a Binet I.Q. of less than 70, the standard by which, in practice, mental defect on the cognitive side is diagnosed, such an individual is thereby irresponsible. The question is complex; in civil life, the law is not clear on the point. Those charged with carrying out the provisions of the Mental Deficiency Acts for local authorities usually advise one of the modes of disposal under these Acts, for such an individual convicted of an offence. In the majority of cases, this is the soundest and wisest pro-I have, however, known judges to sentence an individual with a mental age of 8 or 9 to prison, the legal decision pivoting, of course, on the question of responsibility. In one case I have in mind I think that the judge was right. When we turn to Service practice it may be stated as a fact that not a few individuals with a mental age of no higher than 8 are trainable for certain branches, e.g. seamen, and some have served at sea evidently without attracting attention. If there are no associated psychopathic features, many such might make more satisfactory ratings than some of their more intelligent brethren. When, after a period of service such an individual offends, his irresponsibility cannot be assumed without more ado, merely on the grounds of his mental age. It may very well be that, on the long view, such an individual is a risk and should properly be got rid of by invaliding from a Service which makes such exacting demands on the individual as does the Navy, but unless he shows inefficiency either sustained or intermittent, to such a degree that there are frequent or dangerous lapses, I would hesitate before recommending that he should be invalided. If therefore it is decided to do nothing against retaining him, and even in certain cases where it is, the question of his responsibility and ultimate punishment for an offence must be as carefully weighed as with any other offender referred to you. In some cases this elementary knowledge of right and wrong is present, and they have demonstrated in the past their capacity to obey, even under temptation to do otherwise. If this is so, and no psychopathic features, e.g. morbid anxiety, exist, their responsibility for the offence is very likely great enough to merit punishment. Naturally, it is impossible to lay down general guiding principles. It may very well be felt that sufficient opportunity to offend has not existed up to date, and that the individual concerned has been finally faced with a set of circumstances beyond his intellectual grasp and has taken the short way out. If this is so, then he has proved himself, in virtue of his mental defect, incapable of effective service, and since a similar set of circumstances may easily occur again, the proper course is to invalid him. This is the more usual train of events, but I must make it clear there are exceptions. Even when it is decided to recommend a defective offender for invaliding, you may in virtue of his history to date including the offence, i.e. on a basis of fact, have arrived at the opinion that he is responsible. On the other hand, your belief that he is unlikely to be of further use to the Service is more tenuously grounded, i.e. is essentially a prediction. That again the influence on morale has a strongly determining part in the decision to punish is inescapable.

Lastly mention may be made of the affective changes which are reported in those who have been exposed to cataclysmic happenings, e.g. earthquakes (Bälz, Stierlin), and heavy prolonged enemy action. Thus, Larkworthy (1941) points out that in such circumstances men may be absent from their place of duty or slow in obeying orders and thus be unjustly blamed. In such cases, a remarkable apathy is the change described (affective stupor). The men tend to sit about and to take no interest or part in their surroundings. I have described a similar apathy in those who had been exposed to blast, where it seems it may sometimes last for months.

On the question of disposal of the habitual offender, punishment has proved ineffective in these cases and they are a continual liability or even menace. As far as this Service is concerned up till a month or two ago, the practical alternatives were invaliding, an obviously undesirable course, discharged "Unsuitable" which is regarded with disfavour as a way out, or discharged "Services no longer required" (SNLR). This method is a drastic one since it constitutes a life sentence. Such a man becomes unemployable by any reputable employer for the rest of his life, and is marked ineligible for unemployment benefit. Thus the difficulties in the way of his rehabilitation are considerable. That, on occasions, it has its advantages in respect of certain types of offender is not denied, and it is not suggested that the category should be abolished because, amongst other things, its existence has a probable deterrent effect. But thany habitual offenders may be, and perhaps more often than we think are, corrigible. It seems unjust therefore not to offer such men the opportunity to mend their ways. For this purpose a Labour

Camp has been instituted to which the apparently incorrigible offender and many others, not always offenders, may be sent. The man will go there as a naval rating and be subject to ordinary naval discipline and will work for the common good. The camp has a naval medical officer with psychiatric experience. Since the conditions at this camp are designedly strenuous, it may be expected that a number will, after a longer or shorter period there, prefer to do their duty in the normal way. It seems to me this institution must necessarily have a penal character for which no justification need be offered since judicial punishment at the present day, and increasingly so, has also a therapeutic aspect, perhaps drastic, but by and large, effective. It is in short "corrective". It is too early yet to have ascertained even preliminary results from this interesting experiment, which may well offer guidance after the war in the problem of the disposal of certain types of psychopath.

At present some offenders sentenced to longer terms of detention must do their punishment in civilian gaols. This is an unfortunate state of affairs which has already drawn protest from Lady Astor in a recent letter to *The Times*. The naval correspondent of that newspaper replied shortly afterwards stating that separate detention quarters for naval offenders were being provided. That Service offenders are out of place in an ordinary civilian gaol was also remarked to me recently by the senior medical officer of one of our larger prisons.

In this paper it has been sought to show that in the assessment of the responsibility of naval offenders there is an inevitable shifting of the stress from the individual to the community, yet the rights of the individual are as carefully regarded as is compatible with the necessarily restrictive framework of present-day conditions. The general background of this approach has been described and certain principles which have at least guided me have been outlined. No doubt, individual temperament and character condition to some extent our general attitude to the problems, what must guide our particular approach to such cases is an objective scientific psychiatry, our knowledge of which in many instances will inevitably not be deep enough. This knowledge is the decisive weapon for our task. This is essentially the view of Kinberg, who adds in the article already mentioned that "no jurisprudential philosophical speculations on so-called imputability are needed . . . the conception of imputability is a false abstraction, an inanimate conception, incapable of development which must be cancelled".

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Major E. A. Bennet, R.A.M.C.: In the career of an alleged culprit there are several points at which it may be questioned whether or not be is to be held mentally accountable for his actions. Three of these are of special importance:

(a) When a commanding officer has to decide whether or not he will apply to the convening officer for the trial of a soldier under his command by Field General Court-Martial. (b) When a convening officer decides whether a person should or should not be tried by court-martial. (c) When an accused person is before a military court.

The assessment of mental responsibility appears to be governed by different criteria according to the stage reached in the proceedings. Once a prisoner is before a court a rigid principle in assessment of responsibility must be followed. But this need not apply at the earlier stages. Therefore it will be convenient to consider the question of the assessment of mental responsibility (1) before and (2) after a soldier appears before a military court.

(1) Before a soldier is sent for a court-martial, the assessment of mental responsibility for his act or omission can be considered on a wide, common sense basis. It is recognized that many offenders can be dealt with apart from a court-martial, in a manner which cannot injure military discipline.

Persons suffering from certain degrees of mental defect are likely to fall under this heading. It has been found "that a disproportionately large fraction of the 'population' of military prisons and detention barracks is composed of men below average intelligence and that there is a disturbing incidence of men who are dull and backward."

It is known that many of these persons have fallen into delinquency because they have been given work beyond their capacity and, in consequence, they have become discouraged and emotionally disturbed.

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A recent Army Council Instruction outlines the procedure which should be adopted in dealing with delinquents in the dull and backward group. This procedure is apparently working very well. In the future, it is hoped, no dull and backward person "shall escape appropriate classification" (ibid.) and investigation.

The assessment of mental responsibility in this group is in the hands of a commanding officer or of a convening officer. Their decision, inevitably, is influenced by the result

of selection tests, if known, and by the report of a military psychiatrist.

Another section of persons also falls into this pre-court-martial group, namely those thought to be suffering from psychoneurotic ailment. Unfortunately there is no procedure to deal with this group. A procedure similar to that now used for the dull and backward would be valuable. The vast majority of psychoneurotics should be sent for trial. But there are many exceptions. The sorting of this group is a difficult matter requiring common sense, psychiatric experience, and an appreciation of the part the disposal of such a delinquent may play in the discipline and morale of his unit.

When a careful psychiatric investigation, which should consider appropriate corroborative material, reveals longstanding hysterical ailment in a person who puts forward loss of memory with wandering as an excuse for his misdeed, then it would seem that it is a waste of public money to make application for a court-martial. With similar reservations, an act committed under the unconscious motivation in an obsessional neurosis might call for treatment in hospital rather than for a court-martial. Other conditions which so affect the mind as to reduce responsibility to partial responsibility, are found in confusional states, in schizoid episodes, and in certain classes of persons afflicted with recurrent endogenous depression. The use of the term "partial responsibility" is not unknown in the criminal courts in Scotland. There would seem to be excellent reasons, from a psychiatric point of view, for the use of this concept in the assessment of mental responsibility in the armed forces.

(2) The situation is entirely different once a soldier appears before a court-martial. Provided he is fit to plead and to stand his trial, and assuming that he knew what he was doing at the relevant time, and knew that it was wrong, then he will be convicted provided a case be proved against him.

The "test" here stated, and immortalized in the McNaughton rules, leaves a court no option in the assessment of mental responsibility. There is no halfway house between full responsibility and a criminal lunatic asylum.

That this "test" is not uniformly satisfactory in practice is borne out by the spate of cases in which the interpretation of the McNaughton rules has been disputed.

The McNaughton rules were drawn up in 1843, when psychology, as we know it to-day, had not been born. Consequently we get in the rules certain notions which no one now accepts—such as the concept of partial insanity, reminiscent of the long abandoned faculty psychology. The law cannot operate in academic detachment and apart from human beings. Bad psychiatry, such as that on which the rules are based, must assuredly result in bad law. Efforts have been made from time to time to amend the rules. The most recent attempt appears to have been in 1922; and it is possible that it would have succeeded but for the fact that the proposed alteration failed to obtain official medical support.

The criterion used by a court in deciding upon the degree of mental impairment which frees a prisoner from criminal responsibility is, briefly, whether the prisoner possesses or lacks volition. Would the accused have acted as he did under the eye of the A.P.M.? Psychiatrists argue that there are persons of unsound mental condition who do in fact commit acts, many of them criminal acts, which they detest. They do these acts under urges which are outside their conscious control, and they act, knowing that what they do is wrong, legally and morally. Persons with an obsessional neurosis would fall in this category. The presence of a policeman at their elbow might or might not modify their technique. But it would be simplifying the matter to an absurd degree to argue from this that they possessed the power to avoid the act. The court, representing society, might feel that society had to be protected from such persons and might in consequence commit them to prison. On the other hand, if it could be shown that the person did in fact lack volition, it might be thought that it was a travesty of justice to commit the offender to prison.

Psychiatry in 1843 took no account of mental activity outside consciousness. But psychiatry to-day is well aware of the value of this concept. In fact it is one of the main foundations of modern psychological knowledge. In assessing responsibility, therefore, it would seem that a court should be in a position to consider the view accepted by psychiatrists—that it is possible to distinguish between impulses which are not resisted and those which are irresistible. Clearly it is essential to make this distinction, for every crime, and indeed every act, is done under some impulse and the law sets out to compel people to resist certain impulses.

An act lacking intention could not be described as criminal. Consequently if it could be shown that the act of a person suffering from an obsessional neurosis was committed under the compulsion of an overriding motive, of which the person was unconscious and therefore powerless to resist, that act could not be said to be the result of conscious volition. An individual might be aware that his act was improper and even criminal, and yet it might be that he was powerless to resist the impulse to commit it. It is here contended that such an act lacks volition and for this reason it should not be punishable. The question of the responsibility of a person for an act would be assessed in the particular case by the court. The court being in possession of medical and other reports must decide the question of responsibility in precisely the same way that it decides any other fact and the law assumes responsibility until it is disproved.

Yet if the information given in psychiatric reports indicated that the prisoner, although not certifiably insane, lacked the power of control over his conduct, it is not possible, in the present state of the law, for a military court to act on such a report. They must

proceed according to the rules laid down ninety-nine years ago.

After conviction, a military court can accept any evidence of psychiatric disability which the defence cares to put forward and this will be taken into consideration in deciding the sentence. This evidence is forwarded to the confirming officer who may suspend, mitigate, commute or remit the sentence as he considers just under all the circumstances.

This wise provision gives an opportunity to bring forward matters which might be taken into consideration by the court, prior to passing sentence. It is of practical value, in a psychiatric report presented at this stage, to mention, as a rough grading, that

extenuating circumstances were absent, slight, moderate, or strong.

The proceedings of a court-martial really become a two-stage operation. First the prisoner (assuming he is not insane) is tried, and if found guilty, the court then, but not before, may receive the assistance of modern knowledge in psychiatry before deciding upon a sentence. It is difficult for the layman to appreciate the necessity for this circum-locution. What in effect the court does, once a prisoner is deemed fit to stand his trial, is to disregard the only sort of information which can help them to decide whether as a fact, the prisoner is fully responsible for his action, until the prisoner is found guilty. The difference in the legal and medical concepts would seem to be that in the penal code crimes are certain acts defined in that code which are subject to penalty. And the penal law deals primarily, not with men but with acts of a certain kind. Medical men find it impossible to visualize an act apart from the actor, just as they find it impossible to think of a disease apart from a sick person.

The assessment of mental responsibility must be decided by the court. It would seem therefore advantageous if the court were in a position to receive the type of information

it welcomes later, at the stage before the prisoner is found guilty.

The existence of a confirming officer and his function is, indeed, virtually an admission that a military court, bound as it is by the operation of the criminal law, is apt to adjudicate inadequately in these cases in which mental responsibility is in question.

Dr. W. Norwood East: In civil cases tried by juries at courts of quarter sessions or assizes there is no such verdict as: "Guilty but mentally defective" like there is of "Guilty but insane". On the other hand, if the mental condition of a defective offender is such that he is unfit to plead he is dealt with as an insane person under the Criminal Lunatic Act 1800. The McNaughton rules are likely to remain effective until medical men can introduce an alternative test which juries can understand and evaluate. The existing rules are interpreted, in suitable cases, with elasticity as well as with wisdom so that justice is done. Evidence in regard to the mental condition of accused persons is not always given by expert psychiatrists, and injustice to the public might result if the evidence of an inexperienced medical witness were accepted without There can be no doubt, also, that medical evidence over-reaches itself sometimes and the relation between the mental condition of the defendant and the offence is discounted because the witness tries to prove too much. In the examination of an accused person who is insane it is important to ascertain whether he is also feigning insanity, and some of the most difficult cases are those in which the accused feigns sanity. Whilst no opinion is satisfactory until all the available documentary evidence in the case has been studied the testimony may be misleading until assessed in the light of the medical interview with the accused. I have felt for some time that progress regarding criminal responsibility will largely depend upon psychiatrists leaving this matter to the lawyers, whilst we concentrate our attention upon culpability from the medical aspect, and get better defined views as to what we mean by non-culpability as well as more knowledge concerning the abnormal mental conditions which may properly be held to affect it.

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## Section of Epidemiology and State Medicine

President-E. H. R. HARRIES, M.D.

[May 22, 1942]

## Clinical, Epidemiological and Experimental Observations on an Acute Myalgia of the Neck and Shoulders; Its Possible Relation to Certain Cases of Generalized Fibrositis

By Paul Beeson and T. F. McNair Scott

(With the Assistance of the Public Health Nurses of the Harvard Unit),

American Red Cross-Harvard Field Hospital Unit.

Introduction.—An epidemic of "benign myalgia of the neck" was reported in America in 1935 (Massell and Solomon). The disease was described as typical "stiff neck", or acute torticollis of short duration; although in some instances symptoms persisted for several weeks or tended to recur. Four outbreaks of this disease were studied in England during the winter of 1941-42; the clinical, epidemiological and experimental findings are reported here.

Clinical observations.—Analysis of 125 case records of acute myalgia of the neck and shoulders leads to the definition of certain clinical types of the disease. In most instances the duration of symptoms is short and recovery apparently is complete although the persons are liable to recurrences weeks or months later. In a smaller proportion of cases, perhaps 15%, some aching and stiffness persist for weeks, although not enough to cause interference with daily routine. Finally, an occasional patient has become seriously incapacitated; myalgic areas have appeared in other parts of the body and after several months a disease typical of generalized fibrositis has developed. The case-histories of two patients are given in detail to illustrate courses which the disease may follow.

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\*\*Patients are given in detail to illustrate courses which the disease may follow the head of the was forced to stop work and lie down. He was the fairly comfortable, but may be a some content of the man area of extreme tenderness was found in the left trapezius muscle about the middle of its anterior free margin. On spans was detected, and physical examination was otherwise negative. There was no elevation of temperature. Total leucocytes numbered 8,300, of which 38%, were lymphocytes. Erythrocyte sedimentation (190 mm. tube) was 4 mm. in 60 minutes. On the next day his condition was about the same; but by the third day he had much less pain and was able to move his head fairly comfortably. On the fourth day he was symptom free. For the next tive weeks he remained well. On December 2, without warning, the pain returned and he remained in bed for four days. This again was followed by apparently complete recovery. He went to America in December and has since written that he has had two further attacks similar to twose described.

\*\*Description of an acute myalgia progressing to generalized fibrositis.\*\*—A female laboratory technician, aged 32, awakened on October 15, 1941, with a severe sharp pain in the right side of the neck. This caused her to move her neck and head as little as possible. Examination revealed exquisite tenderness in the portion of the right trapezius was found to be present. One next day it was 11,400, with 34% lymphocytes. Erythrocyte sedimentation was 12 mm. in 60 minutes. The patient remained in bed for five days with persistence of the pain in the right side of the crime

### CHARACTERISTICS OF THE DISEASE

The frequency of various characteristics of myalgia and of its association with the common cold is shown in Table I. The site of the pain was in the region of the trapezius muscle

TABLE I.-CLINICAL FEATURES: ANALYSIS OF 125 CASE-HISTORIES.

		Act	ual number of cases	Per cent.
Pain in neck or	shoulder	s	125	100-0
A. Sharp	***		32	25.6
B. Ache	*** ***		73	58-4
C. Stiff	***	***	20	16.0
Pain on turning	head	***	83	66-4
Tender areas	*** ***	***	69	55.2
Headache	100 000	0.00	60	48.0
General discomi	ort	***	42	33-6
Upper respirator	v infectio	00	51	40.8

in nearly every instance. In some cases painful areas were also present in the deltoid or in the muscles attached to the scapula; the sternocleidomastoid was rarely affected. The common locations of pain are shown in fig. 1, in order of frequency. Often pain was



FIG. 1.—Usual locations of myalgia in order of frequency.

more widely distributed than is indicated in this diagram. The two sides of the body were equally involved. Only 55% of persons complained of tenderness; however, all patients seen in the acute stage have had definite areas of tenderness and we believe, if looked for, this sign would be regularly present. In many cases "nodules" could be felt in the affected muscles. These often could be made to disappear under the influence of heat and massage, and were probably caused by localized muscle spasms. Others however, were more persistent and two consultants who had had wide experience with rheumatic disease, had no hesitation in pronouncing them typical "fibrositic nodules". Pain on turning the head depended on the location of the myalgia. It was usually present when the painful area was along the anterior free border of the trapezius muscle (Area I, on fig. I). Headache, present in about half the cases, was in some instances the chief complaint. It was usually in the occipital region and was associated with myalgic areas near the cranial attachments of the trapezius muscle. General discomfort, described as an "aching sensation", was experienced by one-third of the patients. Fever was not a characteristic of this disease, although in some of the severe cases rises of temperature to 100° F. were occasionally noted. Duration of symptoms, shown in Table II, was less

TABLE IL-DURATION OF SYMPTOMS.

Duration (days)	Cases	Per cent.
1-4	52	55.3
5 — 9 10 — 14	16 11	17·0 11·7
15 or more	15	16.0
Total	94	100-0

than five days in most cases. In a few instances, as previously stated, symptoms lasted for several months. Interference with normal activity occurred in 44% of the 125 cases, but usually lasted only a day or two. Two of the five patients with severe symptoms have been obliged to give up their work. In addition to these, several other persons continue to have symptoms from time to time and are occasionally partially incapacitated. Recurrences: A characteristic feature of this form of myalgia was its tendency to recur after varying intervals of time. In severe cases this tendency was manifested by a series of exacerbations. No constant inciting factor has been ascertained, although chilling, unusual physical exercise such as cycling, and menstruation have all been held responsible

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by patients. The lack of systemic disturbance was often a striking clinical feature. In some cases, however, the patients felt generally ill. One of these had such severe headache that an organic disease of the central nervous system was suspected, and a lumbar puncture was done; the diagnosis became evident later when myalgic areas appeared. No complications such as arthritis were observed. The condition is probably never fatal. Personality changes: Periods of mental depression were invariably noted in the severe cases. Discouragement, weeping, lack of co-operation, and sometimes sullenness were manifestations. This behaviour, coupled with such indefinite complaints as numbness in the hands, and with little objective evidence of disease, could easily lead to a mistaken diagnosis of psychoneurosis.

Laboratory data.—The leucocyte count was ordinarily within normal limits; there was often a moderate lymphocytosis. Erythrocyte sedimentation rate was always normal. Throat cultures showed only normal bacterial flora. Several blood cultures were made

in the more severe cases and were invariably sterile,

Relation to fibrositis.—In 5 of the 125 cases detected in the surveys (2 from the hospital, 2 from the factory and 1 from the A.T.S. unit) the disease has followed a protracted course, and the patients now appear to have rather severe, generalized fibrositis.

Association of acute myalgia with common cold.—51 of the 125 cases of myalgia (41%) gave a history of common cold at the time of the onset of myalgia. This appears to be more than a chance association, but its significance is uncertain. It is worth noting that the symptoms of both conditions are aggravated by exposure.

### **EPIDEMIOLOGICAL OBSERVATIONS**

In October 1941, several cases of "stiff neck" occurred among members of the staff of the American Red Cross-Harvard Field Hospital Unit. All persons in the community were, therefore, canvassed in order to determine the prevalence of the condition. This revealed that a considerable number of persons had suffered an attack of myalgia in the neck or shoulder regions within the preceding two-month period. Similar cases of myalgia were reported in a nearby factory and also among a Unit of the Auxiliary Territorial Service billeted in the neighbourhood. Systematic inquiries disclosed a recent high incidence of acute myalgia in these two groups. A fourth survey was made among a detachment of soldiers. The incidence of myalgia in that community was considerably less than that found in the other groups.

In order to evaluate the apparent high incidence of myalgia in the first three groups of people, the follow-up surveys were made for comparison. In each community more than half of the persons interviewed in the follow-up survey had been interviewed in the original one. Living and working conditions were similar throughout both periods. All studies were completed between October 1941 and April 1942. The weather was con-

sistently cool or cold.

### METHOD OF SURVEY

All persons in the communities involved were interviewed by trained public health nurses. The nurses had been instructed in the nature of the disease and in the purpose of the inquiry and had been given special charts for recording their findings. Many persons who had been recently affected with myalgia were also examined by a physician. Questionable cases were excluded, and in the follow-up surveys persons still having symptoms which had begun during the original surveys were omitted. The data are, of course, subject to the usual limitations of the survey method, since reliance must necessarily be placed on the patients' recollection of symptoms. Rècent attacks were more clearly remembered than those six or eight weeks past. There was a noticeable tendency for dates of onset to be grouped around the "first", "tenth", or "fifteenth" of a month. Nevertheless the total picture is believed to be fair and comparison of findings in two surveys of a given community is reasonable.

Findings of surveys.—A graphic representation of the case incidence in the first three communities is shown in fig. 2. A total of 84 cases occurred during the original survey periods compared with 41 cases in the later ones. Details of the conditions in these com-

munities are given below:

Auxiliary Territorial Service Unit.—This was a group of young women whose duties were mainly clerical. They lived in a former boys' school, and in seven neighbouring residences. There was relatively little contact between residents of the different houses. The two surveys in this group represent essentially a continuous record, since the interval between the end of the first and the beginning of the second was only two weeks. In the October-December survey 24 cases were found among 177 women, an attack rate of 13.6%. There was some grouping of cases in the first week of December. During the second two-month period only seven cases were identified among 165 women, an attack rate of only 4.2%. During the first survey there was a considerable difference in incidence of the condition among occupants of different dormitories. Table III shows the rates in the

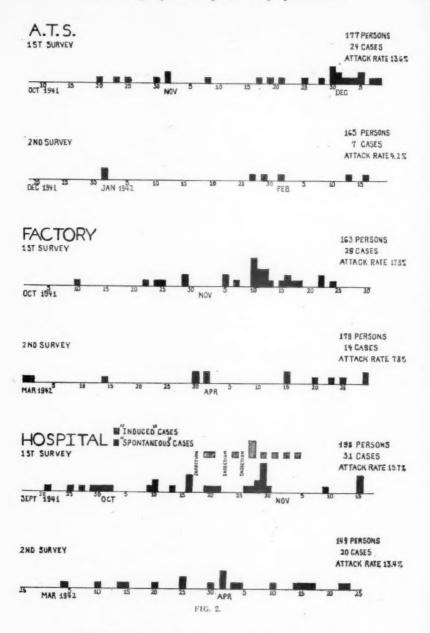


TABLE III.-INCIDENCE IN DIFFERENT DORMITORIES-A.T.S. UNIT.

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Dormitory	Person-weeks	Cases	Rate %
1	347	15	4.3
2	218	2	0.9
3	210	2	0.9
6	127	4	3.1
1.0	5.5	11	

four largest: 4.3% and 3.1% in two dormitories and only 0.9% in the other two. The distribution of the seven cases found in the follow-up period was such that the rate was not above 0.9% in any dormitory. Because there had been some changing of residences the attack rates quoted were computed on the basis of person-weeks in each residence. Cases were allotted to the dormitory in which the affected person had spent the preceding ten days.

Factory.—A description of this factory and an analysis of the original survey have already been reported (Beeson and Scott, 1941). At that time 29 cases were found among 163 people interviewed, an attack rate of 17.8%. The second survey was made after an interval of thirteen weeks and covered the months of March and April 1942. Out of 179 persons interviewed only 14 cases were found. Thus the attack rate had fallen from 17.8 to 7.8%.

Hospital Unit.—The first survey in this community covered the period between September 17 and November 17. Among 198 persons interviewed there had been 31 cases of myalgia. The follow-up survey disclosed that in March and April there were 20 cases among 149 persons. Thus the attack rate in the whole community had changed only from 15.7% to 13.4%. On further analysis, however, it was found that the incidence of disease fluctuated considerably among the different groups of personnel. In the autumn period the attack rate among the 72 persons who lived and took all their meals in the hospital (doctors, nurses, technicians and orderlies) had been 23.6%, while in the spring this had fallen to 11.6% among 95 residents. In the non-resident group (clerks, domestic helpers, construction workers) the rate was only 11.6% among 126 persons in the autumn, but rose to 27.3% among 33 non-residents in the spring. The findings indicate that the greatest prevalence of the disease shifted during the winter from the resident group to the non-resident group. (Omitted from the first survey were 24 persons who took part in the transmission experiments.)

Soldiers.—Cases of myalgia had been reported among some soldiers in a tank training regiment. A survey was made, covering the months of October and November 1941. Only 17 cases were identified among 278 men, an attack rate of 6·1%. A second survey in this group could not be done. The data obtained in this community are not, therefore, included in the remainder of this report.

History of previous attacks of stiff neck.—All of the 1,031 persons interviewed in the three communities were asked whether or not they had suffered from "stiff neck" in the past. Of the 125 persons who had recently suffered myalgia, 62 or 49.6%, gave a history of previous attacks. This is at variance with the findings of Massell and Solomon (1935), who stated that none of their patients remembered having suffered from this condition before. Of the 906 persons who had not had myalgia within the periods of our surveys, only 201, or 22.2% remembered having had a "stiff neck" in the past. This difference between persons who were recently affected and those who were not, suggests that there may be individual differences in susceptibility to the condition.

Attack rate according to age.—Ages of persons in the surveyed population ranged from 15 to 70 years, the majority being young adults. The attack rates were highest in adults of middle age (Table IV), being lower in young adults and declining progressively with advanced age.

TABLE IV.-ATTACK RATE ACCORDING TO AGE.

Age-group (years)	Number of persons	Cases	Attack
15 19	149	16	10.7
20 29	478	52	10-9
20 — 29 30 — 39	193	29	15.0
40 - 49	131	19	14.5
50 59	46	6	13.0
60 - 69	34	3	8.8
	Total 1,031	125	12-1

Sex incidence.—Our data are not suitable for analysis in regard to sex incidence because the proportion of males was small and the average age of males was considerably higher than that of females. Nevertheless it may be significant that the attack rate was low in the group of soldiers surveyed, that it was lower in male factory workers than in female factory workers, and that it was low among the construction men in the hospital community. Because of the usual mildness of the disease it is possible that men accustomed to hard manual labour would be less apt to remember an attack of myalgia than would women.

Communicability.—The fluctuating incidence of this condition and the variation in incidence in different groups within the same community are characteristic of an infectious disease. In these studies no evidence of transfer by contact with affected persons was obtained. Many persons who were close associates of patients did not develop symptoms. Conversely, the disease developed several times in hospital patients who had been on isolation precautions for other conditions, and who apparently had no contact with an attendant who had symptoms of myalgia. There is nothing to suggest that the causative

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agent is conveyed by food. The epidemiological characteristics of this disease resemble those of diseases which are spread through the agency of latent or sub-clinical cases. The probable existence of such cases is indicated by the mildness of many manifest cases and by the frequency with which symptoms recur after free intervals.

### EXPERIMENTAL OBSERVATIONS

Experiments were performed in an effort to determine the transmissibility of the disease to human and other hosts. Materials used were: (1) washings from the nose and throat, and (2) whole blood.

Transmission to human volunteers.—(1) Washings from nose and throat: Normal persons were treated with washings from the noses and throats of patients with myalgia. The washings were first rendered bacteriologically sterile by Berkefeld filtration, or were grossly freed of bacteria by angle centrifugation. The materials were sprayed into the noses and throats of volunteer subjects twice a day for five days. One of six persons so treated developed myalgia thirteen days after the last spraying. This was an incidence no greater than that in the community at large and, therefore, probably lacked significance. Twelve other persons—Groups Å and B to be described—were sprayed, in addition to receiving blood. Four of them developed myalgia. Since the attack rate among persons of Group C, who received only blood, was still greater the evidence did not suggest that washings contained an infectious agent.

(2) Whole blood: The plan of these experiments is illustrated in fig. 3. In all experiments blood was drawn with an all-glass syringe and defibrinated with glass beads using

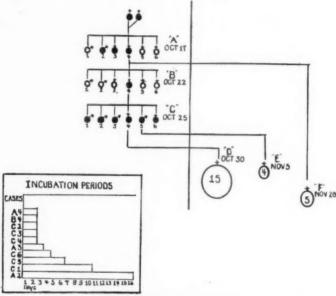


FIG. 3.-Cases of myalgia among volunteers.

sterile precautions. The blood used for the first group of volunteers—Group A—was obtained on October 17 from the two patients who had become ill with myalgia on the previous day. The blood was pooled, both donors belonging to blood group O, and was administered intravenously in amounts of 10 c.c. to each of six normal persons. Three developed myalgia. Patient A4, who showed typical "stiff neck" forty-eight hours after receiving the blood served as the donor for B Group. Each of the six received 5 c.c. of blood intravenously on October 22, and one of the six (B4) had a "stiff neck" forty-eight hours later. About the same time another member of B Group had a mild pain in the neck which lasted only a few hours. Because of the mildness and brief duration of the pain this person was not considered a definite case of myalgia. On October 25, the day after onset of symptoms, blood from patient B4 was administered to the six members of Group C; five received 1 to 4 c.c. intravenously and one received 3 c.c. intramuscularly. All of these developed myalgia within ten days.

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Since myalgia was currently prevalent in the population from which these volunteers were drawn it was impossible to conclude that the disease resulted from the inoculations. Consequently four attempts at transmission were made in communities some distance away and free from spontaneous cases. Blood from patient C4 was used for the first of these attempts. The blood was taken on October 27, the day of onset of symptoms, but was not used until October 30. During the interval three means of preservation were employed: part was stored at 7° C.; a second part was frozen at  $-10^{\circ}$  C.; the third portion was dried by the Cryochem process, the last two procedures causing hæmolysis. Fifteen middle-aged women (Group D) volunteered for the tests. The two hæmolysed portions were given intransucularly to two groups of five persons, in amounts of 3 c.c. The remaining five received intravenously, 1 c.c. of the blood which had been kept at 7° C. No case of myalgia resulted.

A second trial (Group E) with four of the same volunteers was made six days later using freshly drawn defibrinated blood from patient C5; this had been transported in ice and was administered intravenously in amounts of 5 c.c. within six hours. None of them developed myalgia.

A third trial (Group F) was made on November 20, with five of the original Group D. The blood was obtained from patient A4, who was suffering a severe exacerbation of her disease. The blood was treated as before and 5 c.c. were given intravenously to each, but no case of myalgia resulted.

A fourth trial was made on March 1, with four middle-aged men (Group G, not shown in figure). Blood from a patient in the fifth day of myalgia, treated as in the last two trials was used. 6 c.c. were given intravenously to each of the volunteers but no case of myalgia resulted.

Comment.—The transmission experiment using filtered or centrifuged washings from nose and throat was not impressive, since only one of six persons contracted myalgia, a frequency about the same as that of the spontaneous disease at the time. The results of the first experiments with blood were much more suggestive. Ten of 18 persons, in three successive generations, developed myalgia. This was an attack rate of 55.5% in a period When the incidence of the spontaneous disease among the 166 susof seventeen days. ceptibles1 of the Hospital Unit was calculated for the same period of time it was found to be thirteen cases, or 7.8% (observed difference = 48%. Standard error diff. = 12. Quot, The incubation periods in seven of the ten experimental patients were from two to four days. In the other three cases the onset was seven, ten, and sixteen days after inocula-In Group C the results were particularly impressive, since all had myalgia within the succeeding ten days. The experimental disease was identical with that observed in spontaneous cases, except that the proportion of severe and prolonged illnesses was greater. Three of the experimental patients—A4, B4 and C4—have had clinical courses which resembled that of Case 2, previously described. The unusual severity could be due to heavy dosage, or to the great virulence of an infectious agent; this increased virulence could have been due to the intravenous route of inoculation or to rapid passage through a susceptible

Certain facts may be cited in explanation of the failure to transmit the disease in other communities. Group D: The blood had been stored for three days before use. Under these conditions an infectious agent might no longer be active. Group E: Only four persons were concerned, and the blood was from a patient whose symptoms subsided on the following day. Fortuitously in Groups A, B, and C, the donors had been patients in whom the subsequent disease was severe. Groups F and G: The bloods used were from patients who had been ill for thirty-two and five days, respectively. It is distinctly possible that an infectious agent might have left the blood in this time.

### Attempted Transmission to other Hosts

All efforts to establish the disease in animals, and in the developing chick embryo, were unsuccessful. Portions of the same materials used for volunteers were employed as follows:

Nose	and	throat	wasl	hings	***	Mice Intranasally	Guinea-pigs Intranasally	Rabbits Intranasally
Blood	1	***	***	***	***	Intracerebrally Intraperitoneally	Intramuscularly Intraperitoneally Subcutaneously Under foot pads	Intracerebrally Intravenously On the scarified cornea

Developing eggs were inoculated with blood on the chorio-allantoic membrane and into the allantoic sac. Many "blind" passages were made by these routes and also by the intra-amniotic route, with consistently negative results.

Comment.—No evidence of illness or of pathological change was observed in these

<sup>1.</sup> Susceptibles equal total population minus inoculated persons minus those having had the disease in previous month, or 190 - 10 - 14 = 166.

hosts. It is quite possible that a disease which produces so little systemic reaction in human beings would not be detectable in the experimental animals used.

#### DISCUSSION

The form of myalgia described here is not Bornholm disease, which unfortunately has been given the all-inclusive name "epidemic myalgia". Bornholm disease seldom involves the trapezius muscle, and in addition differs by reason of its characteristic pleural pain, fever and leucocytosis (Sylvest, 1934). Recently two other epidemic diseases have been described under the titles which suggested a possible identity with our cases. These are: "Epidemic Myositis, with Neuritis, Erythema and Meningeal Symptoms" (Williams, 1941), and "Brachial Neuritis Occurring in Epidemic Form" (Wyburn-Mason, 1941). The clinical descriptions given show very little resemblance to the disease considered here. An epidemic disease which closely resembles the one under discussion is "Persistent Myalgia Following Sore Throat" (Houghton and Jones, 1942). They describe an outbreak of seven cases among a group of hospital nurses characterized by severe headache and mental depression in addition to myalgic areas in various parts of the body. Their cases differ from ours, however, by the presence of persistent fever, epistaxes and subungual hæmorrhages.

The data obtained in the surveys show that acute myalgia of the neck and shoulders can occur in epidemics. Outbreaks of the disease are not easily recognized because of the general mildness of the symptoms, the slight interference with ordinary activities, and the absence of fatal cases. Furthermore, the dispersion of cases in an outbreak shows little sharp grouping. In the epidemics recorded here it is of interest that the medical officers in charge were unaware of the large number of cases in the communities under their care. It is probable that epidemics frequently occur, but are seldom recognized.

The widespread opinion that exposure to cold or draught tends to induce this form of myalgia cannot be readily dismissed. Assuming that the disease is caused by a specific infectious agent, such physical factors as cold or draught may well influence its development; analogies might be drawn with the common cold or herpes simplex

The evidence for experimental transmission of myalgia is incomplete. The disease could not be produced in the experimental animals used. The apparent transmission to volunteers is subject to the criticism that these were members of a community in which the disease was currently prevalent and that the condition was not transmitted in other communities. The points in favour of experimental transmission are: First, the incidence of myalgia in the volunteers was far higher than in the remainder, of the community, Statistically, the probability of this difference being due to chance is less than 1:10,000. Second, the incubation period in seven out of the ten volunteers was two to four days after inoculation. Third, the proportion of severe illnesses in the group was greater than among those who acquired the disease spontaneously. Fourth, reasonable explanations have been offered for the failure to transmit the disease in other communities. Final proof of this matter must await further evidence.

### SUMMARY AND CONCLUSIONS

Epidemiological studies on acute myalgia of the neck and shoulder regions have been made in small groups of people in England during the winter of 1941-42. The evidence obtained indicates that the prevalence of this condition fluctuates in a manner similar to that of a communicable disease.

The clinical characteristics of this type of myalgia have been studied by an analysis of 125 cases which were detected during the epidemiological investigations. Certain clinical types have been defined. Most affected persons have a mild, self-limited illness of fairly uniform course, but occasionally the disease passes into a chronic form, extends to other parts of the body, and eventually produces the clinical syndrome of generalized These chronic cases would not ordinarily be identified as having originated from an epidemic of benign myalgia of the neck.

Experiments were performed in an effort to determine the transmissibility of the disease to human beings and to experimental animals. Transmission to human beings appeared to be accomplished through the agency of whole blood from acute cases, although the evidence is not conclusive because of the prevalence of the disease in the community at the same time. Attempts to establish the disease in other hosts were unsuccessful.

The evidence from these investigations supports the concept that acute myalgia of the neck and shoulders should be regarded as an infectious disease.

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# Section of the History of Medicine

President-J. F. HALLS DALLY, M.D.

[June 3, 1942]

## The Development of Hospital Services with Particular Reference to the Municipal Hospital System of London

By REGINALD COLEMAN, Barrister-at-law, and W. Allen Daley, M.D.

BRIEF EARLY HISTORY OF HOSPITALS-TO 1600(a)

It is consoling to our humanitarian instincts that researches confirm what we would all like to believe, namely, that the care of the maimed and sick is deeply rooted in the early history of mankind. "Doctors" appear very soon upon the scene of life, for example: Solus of Assyria. Egypt, China, India, Greece and Rome all had hospitals. Egypt and Rome had State-paid doctors. The word "hospes" connotes both host and guest and the idea of a "hospital" therefore lies in hospitality, a characteristic of early civilizations. Hence the monastery "hospitium" and "hospice" and the present-day Chelsea Royal Hospital and Greenwich Hospital. At the beginning, the doctors were the priests—thus inaugurating that close connexion between religion and the churches and medicine and hospitals (care of soul and body) which in some forms—such as the Archbishop of Canterbury's power to confer the "M.D. Lambeth", and hospitals affed by nuns—still continues. Rome had "specialists" (aurists, oculists, dentists) and some of its hospitals were put into the purer air of the country. Bishop Basil founded a hospital at Caesarea (A.D. 370) and Archbishop Chrysostom at Constantinople (A.D. 400).

In Early England—as on the Continent—the Church, especially the religious communities, provided the hospitals, the development of which was stimulated by the need for caring for lepers(b), by devastating periodical plagues (e.g. the Black Death in the fourteenth century), epidemics of cholera, and by the poverty and servitude of the working people, who could make no provision from their own resources. The incidence of leprosy, which already existed in England in the fifth century, was increased by returning Crusaders—and so necessitated many "isolation" hospitals, "houses of separation", lazar-houses, "leprosaria". Liberton ("Leper-town") near Edinburgh was a leper community. The oldest hospital still functioning (St. Bartholomew's, Rochester) started in 1078 as a leper hospital. Amongst the Religious Orders doing much hospital work were the Knights of St. John, Knights of Malta, and particularly the Order of St. Vincent de Paul. A "Hospital" was an incorporated almshouse just like a university college, save that its aims were eleemosynary and not educational. The hospital or "House of Pity" was usually in the Bishop's House, from which it spread to separate ad hoc buildings, the clinic and the infirmary. Poverty (always allied to sickness) was the only common denominator of the patients, and it may be said that all these places were more for care than cure. The first general hospital in England, St. Peter's, York, was instituted by King Athelstan and the Cathedral Canons. St. John's, York, was founded by Lanfranc, Archbishop of Canterbury, in 1084.

St. Bartholomew's, London, was founded in 1123 by Rahere, Henry I's jester(c). St. Thomas's began its great work in 1200. These, with all other similar monastic foundations, were abolished by Henry VIII in 1538, and being without funds their work practically ceased. The King could not very well allow this to happen; he was therefore compelled (with the City Corporation) to afford financial help. For this reason these two, with three others (Christ's, Bridewell and Bethlem (St. Mary's or Bedlam)) became known as "Royal" Hospitals(d). They were "rate-aided". This connexion with the parochial system of the City of London may well be regarded as the embryo of public hospitals, and provides an interesting mediæval example of a service comprising several "hospitals" connected together and dealing with both bodily and mental ailments. Incidentally the provision of "State-aid" to charitable organizations is no new thing. King's College, Cambridge, and Eton College (founded by Henry VI) owed much to

"forced benevolences", an early form of taxation, as did Cardinal Wolsey's Ipswich Schools and Christ Church, Oxford.

The Tudor period, with the final legislation of Queen Elizabeth, saw the divergence of the voluntary from the "State" hospital, which, under the Poor Law, then began its separate career.

### THE VOLUNTARY HOSPITALS(e)

The voluntary hospital movement made great progress in the first half of the nineteenth century, when the industrial revolution created great fortunes for the few and much suffering for the many. The springs of benevolence flowed freely to mitigate the hardships of the poor. The Westminster (1719), Guy's (1724), St. George's (1733), London (1740), the Middlesex (1745), and others had been founded earlier, but between 1800-1850 there were added Charing Cross, the Seamen's, Royal Free, University College, King's College, St. Mary's, the Royal Northern. Manchester saw the first fever hospital. The London Fever Hospital, now no longer used for the reception of fever patients, was for many years prior to 1939 the only voluntary fever hospital in this country. It was founded in 1802. The Society of Friends started an Asylum for Lunatics in York in 1788. Cottage hospitals (peculiar to Great Britain and the U.S.A.) were started by Albert Napper, F.R.C.S.(f). The first out-patient department or dispensary was opened in 1700. Convalescent hospitals are a recent but growing development(g), as are wards or special blocks for "paying"(h) or "private" patients (although of course financial stringency has resulted in all patients being asked to pay what they can. "Supported by voluntary contributions only "probably does not now apply to any hospital). The fever and mental hospitals were the first hospitals, built as such and not originating in sick wards of workhouses, to be provided entirely from public funds. The National Insurance Act, 1911, was the first great step towards the State provision of medical services on the grand scale. The rate- or tax-supported personal health services now include the School Medical Service, Maternity and Child Welfare Services, Tuberculosis and Venereal Diseases Schemes and the medical work of the Ministry of Pensions. As part of many of these services the voluntary hospitals work for, and are paid by, the local authority or the State. All the above are apart from the provision of hospital services per se by local authorities.

### THE POOR LAW HOSPITALS-TO 1930(1)

The great Poor Law Statute of 1601 (Eliz. 43, Cap. 2) initiated that vast system of Public Assistance to the destitute known as "The Poor Law". Previously the "voluntary" subscriptions of the public had to be subjected to pressure by bishop and parson to secure their sufficiency and continuity. A poor rate was levied by the Overseers of the Poor. Children were set to work, the lame, impotent, old, blind and others "being poor and unable to work" were catered for. The home of the homeless or the poorhouse was at first in cottages, then in the old-fashioned workhouse (still to be seen in country districts). Improvements were effected (e.g. combinations of the units, the ecclesiastical parishes), and, following a Royal Commission, the Poor Law Act of 1834 brought about great reforms. New and larger areas of administration-Unions-were created, Guardians succeeded the Overseers, classification of inmates was commenced and Government control and oversight in the form of the Poor Law Commissioners (which became the Poor Law Board in 1847, the Local Government Board in 1871 and the Ministry of Health in 1919) were established. The sick were taken from their homes (in 1868 two-thirds of the sick poor had domiciliary treatment only) to the workhouse sick wards, which developed after 1867 into the "separate" infirmary or Poor Law hospital. This was a substantial advance. In it appeared good medical and nursing staffs. London pioneered the separate infirmaries, followed by Manchester, Birmingham, Leeds, &c. Training schools for nurses were established; but the honour of being the first Poor Law institution to do this goes to the Liverpool (Brownlow Hill) Infirmary in 1865, followed by the London Marylebone Infirmary (now St. Charles' L.C.C. Hospital) in 1884. Classification of patients became essential. The voluntary hospitals have always been averse from receiving mental cases, "chronics" (those with advanced heart or lung disease, incurable lesions of the nervous system, inoperable cancers, the senile, the epileptic, &c.), the tuberculous and infectious. All these went, or were referred, to the Poor Law infirmaries. The Metropolitan Poor Act (the Gathorne Hardy Act) of 1867 is a great landmark in the hospital history of London. It founded the Metropolitan Asylums Board and with it there appeared the first organized hospital system in this country. Before describing that system as it had developed in 1930, it is necessary to consider

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the "general" hospitals which the L.C.C. inherited also in that year from the Metropolitan Boards of Guardians.

The earliest separate infirmaries were St. Pancras, St. George-in-the-East and Wandsworth. By 1930 all the London Boards had established "separate" Poor Law hospitals. In the early days, the relieving officer's order was an essential preliminary to the admission of a patient but the medical superintendent always had power to admit "emergency and urgent" cases, and it was by an elastic use of these words—brought about largely by the pressure of public opinion—that more and more patients were admitted direct by the medical superintendent. More and more acute cases were admitted, in addition to the "chronics". Operating theatres, X-ray departments and maternity units were provided at all, and special clinics, such as for radium therapy, at some—so much so that thousands of patients quite outside the scope of the destitute Poor Law class were admitted, paying for their treatment as they could afford.

Since the 1914-18 war there has been a very great increase in "hospitalization". Many thousands now turn to hospitals, as in-, or out-patients, who, thirty years ago, would never have dreamt of doing so. Small houses, lack of servants, greater confidence in hospitals and the increasing complexity of treatment—all have played their part in this.

Another cause of the increasing use made of the Poor Law hospitals was the inability of the voluntary hospitals to deal with the growing demands of the sick poor. In 1909 throughout the country the voluntary hospitals had provided in all some 25,000 beds. In the same year there were 100,000 sick beds in the Poor Law institutions and infirmaries actually occupied by patients(k). The voluntary hospitals also have (especially those with medical schools) always adopted a "selective" method for admission to their wards; they are unwilling to accept patients who are likely to occupy beds for prolonged periods and the "interest" of the case is at times an important factor bearing on admission or rejection, whereas of course the municipal hospital must accept all comers who are destitute in that they need hospital treatment and cannot otherwise obtain it. Thus, when the L.C.C. took over the 29 general Poor Law hospitals in 1930, although they were not a unified service such as the M.A.B. "special" hospitals had become, and although they differed very much in their general standards and popularity, nevertheless they constituted a series of efficient institutions and gave the London County Council a good start in the evolution of a municipal general hospital service for the metropolis.

On the question of municipal hospitals generally we should refer to what was known as the "Bradford" experiment. Section 131 of the Public Health Act, 1875(1) gave local authorities power to provide hospitals for the inhabitants of their districts (and to recover the cost of treatment from the patients)—but only one municipality, Bradford, used these powers, and established in 1920 a municipal general hospital, the only one prior to 1930 except the small hospital provided by the Borough of Barry. St. Luke's, Bradford, had 900 beds, a large consulting staff and was governed by the Corporation Health Committee. The powers of Section 131 were conferred on County Councils by the Local Government

Act, 1929 (Sec. 14).

### THE METROPOLITAN ASYLUMS BOARD(m)

The main object of the Metropolitan Poor Act, 1867, was to achieve better classification throughout London of Poor Law cases. There were too many Boards of Guardians for each to make provision for "special" cases such as fever, smallpox, mental defective, boys for sea-training (the T.S. "Exmouth"); and a metropolitan central authority was the best solution. Thereby the cost of dealing with these "special" classes was equalized (through the Metropolitan Common Poor Fund, established by the Act) over the whole of London. The work of dealing with sick children was given to the M.A.B. in 1897 and the responsibility for the casual poor was transferred to the Board in 1911. In 1928 the management of the Metropolitan Common Poor Fund was entrusted to the Board.

Prior to 1867 there was no organized provision in London for the isolation of fever cases. There were two private hospitals for paying patients and the workhouse infirmaries provided isolation units for the poor. The Eastern, South-Western and North-Western hospitals were soon built by the M.A.B. The smallpox epidemic of 1870-71 and another in 1876-8, put great strain on the accommodation. A hospital ship "Dreadnought", lent by the Government, was moored off Greenwich and a camp of tents for convalescents was erected at Dartford. The Board could only admit to its hospitals "pauper" patients and the general public clamoured for the removal of this limitation. There was no compulsory notification of infectious diseases and consequently the control of epidemics was impossible. The Royal Commission of 1881, appointed to consider these difficulties, recommended that (a) Fever hospitals should be entirely disconnected from the Poor Law.

(b) Fevers should be notified to district medical officers of health. (c) Hospitals in London should be for "fever"; smallpox patients should go to Dartford. (d) Country convalescent

fever hospitals should be established.

(a) was achieved by the Diseases Prevention (London) Act, 1883 (Poor Law Acts, 1889, and Public Health (London) Act, 1891). (b) was implemented by the Infectious Diseases Notification Act, 1889. (c) The hospital ships "Atlas" and "Endymion" and "Castalia" (superseding the "Dreadnought") were moored off Dartford. Permanent hospitals were built (Joyce Green, Orchard, Long Reach) and the ships given up in 1904. Patients were conveyed, owing to the time taken by horse ambulance, from wharves in London by river ambulance steamers; now all smallpox cases go to Dartford by motor ambulance.

(d) The Board built two large convalescent fever hospitals in the country.

Like the general hospitals, the infectious hospitals soon became popular. The proportion of admissions (scarlet and enteric fever and diphtheria) to notifications in 1890 was 33.6%, and in 1929, 93.5% (in the case of all notifiable diseases admitted)(n). The mortality rates, on the contrary, fell. In 1890 they were in the case of diphtheria 30%, in 1929, 3%; in scarlet fever 6% and 0.6%, respectively. The Board's ambulance service, started in 1879, grew with its use and developed into a most efficient system with six large ambulance stations and over 150 motor vehicles(o). Measles and whooping-cough were admitted. Hospitals or units were provided for V.D., ophthalmia neonatorum, zymotic enteritis, encephalitis lethargica, juvenile rheumatism, mastoiditis, cancer of the uterus, &c. Classes for the instruction of medical students in fevers and smallpox were established in 1889. The immunity of the smallpox staff from the disease was remarkable. From 1884-1901, 17,900 smallpox cases were treated by 2,198 staff, not one of whom, where there had been successful revaccination, contracted the disease; later records show similar results. The Board made its own diphtheria antitoxin at the Belmont laboratories and stables, where there was a bacteriologist responsible also for the general bacteriological work of all the hospitals. Two group laboratories were provided, also hospital laboratories in each hospital; and a general director of research and pathological services appointed.

The M.A.B. also established asylums for imbeciles and the feeble-minded(p). Darenth, for improvables, was a most successful institution, a large amount of useful work being done there in the schools and workshops. From the latter goods to the value of over £70,000 per annum were turned out. An interesting experiment was conducted—most successfully—at Tooting Bec Asylum, where aged senile cases were, and are, received without any "certificate" under the Lunacy Acts (to avoid stigma on the patient or relatives). Its name was altered (anticipating later general titular amendment) to Tooting

Bec Hospital.

The Board built new or adapted existing buildings as hospitals for (a) children suffering from ophthalmia, ringworm and other skin diseases; (b) epileptics; (c) the convalescent (seaside hospitals). Their Queen Mary's Hospital at Carshalton is the largest children's hospital in this country and probably in the world (1,284 beds). The history of the treatment of Poor Law children suffering from trachoma and of the investigations which led to the building of High Wood and White Oak Hospitals are of great interest and are dealt with fully in an article in the L.C.C. Annual Report, 1935(q).

Another important branch of the Board's work was the provision of hospitals and sanatoria for the tuberculous, initiated to give the "sanatorium benefit" created by the National Insurance Act, 1911, and continued under another guise by the Act of 1920(r). Almost from the inception of the scheme insured and non-insured were admitted alike.

Some of these institutions were specially built and others adapted.

In 1930 the L.C.C. found it much easier to "take over" the M.A.B. special hospitals, which the Board had welded into a homogeneous, efficient, unified service, than it was to take over the general hospitals, which came to it from 25 different Boards of Guardians, each with its own system.

### THE LOCAL GOVERNMENT ACT, 1929-THE LONDON COUNTY COUNCIL(s)

The Local Government Act, 1929, dealt with the transfer of functions, powers and duties from the Poor Law authorities to the County and County Borough Councils, the major local authorities, on whom the Minister of Health in a recent Parliamentary statement said he intended to place additional responsibilities in connexion with hospital work. The most important section of the Act of 1929 was the first, which says simply that on April 1, 1930, the functions of each Poor Law authority shall be transferred to the

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Council of the County . . . and as from that day all then existing Poor Law authorities shall cease to exist.

The great advantage of this Act was that it removed the handicap to health authorities which arose through their having, in practice, no control over the rate-supported general hospitals as they were administered by separate local authorities. The provincial health authorities had provided maternity hospitals, sanatoria, fever and sometimes orthopædic hospitals whilst the Guardians had often provided accommodation for the same classes of patients. At long last this Act of 1929 integrated the public hospital and public health services of the major local government areas.

"Appropriation"(t).—The County Council could have continued to administer under the Poor Law Acts the hospitals transferred to it, but it adopted the alternative and enlightened policy of administering them under the Public Health Acts. This necessitated changes in accountancy, meant that costs of treatment are recovered under the Public Health instead of the Poor Law Acts, and removed the hospitals from the detailed oversight of the Ministry of Health which is exercised over Poor Law establishments.

(u)There were transferred to the Council seventy-six general and special hospitals, containing 37,202 beds. With the 22 mental hospitals they make a grand total of 98 hospitals and 71,771 beds administered as one complete hospital system. The "special" units(v) are of considerable interest, including as they do inter alia the Plastic Surgery Unit under Sir Harold Gillies at St. Charles' Hospital, the Thyroid Unit at New End Hospital which was initiated by Sir Thomas Dunhill, and the Units at Lambeth Hospital (cancer of the uterus under Sir Comyns Berkeley and the cardio-vascular Unit under Viscount Dawson of Penn, and the late Lawrence O'Shaughnessy).

A few summarized statistics of the hospitals show 52,000 more admissions in 1937 than in 1931—an increase of 26% and a total of over a quarter of a million in-patients treated (apart from the mental hospitals).

It should be noted that throughout this paper, save in one or two instances where the war is specifically mentioned, we deal with the state of things as existed in August 1939, though the statistics given are in most cases for 1937—the latest year in respect of which complete figures are readily available,

The war wrought tremendous changes in the London hospital services which cannot be described here. This much can, however, be said—that London would have been inadequately prepared for the strain aerial warfare placed upon its hospital resources had it not been for the development of the L.C.C. hospital services which took place between 1930 and 1939. The pity is that the steady development which had been going on was stopped by the tragic events of 1939.

Head office organization.—It may be of interest to describe how a great hospital service is organized centrally. To assist the Medical Officer of Health there are, in addition to a Deputy, two Principal Medical Officers (one in charge of the hospitals and the other of the public health work generally and the School Medical Service) and other medical staff. The Department is classified into four Divisions (Hospitals, General Public Health, Staff and Finance) plus the Ambulance Service—and the Mental Health Service. There is a Chief Clerk, an administrative officer in charge of the Mental Health Service, four Principal Clerks (one in charge of each Division) and a large clerical staff. There are also at County Hall a Chief Dental Surgeon, Ophthalmologist, Aurist and other specialist medical and surgical staff, a Chief Chemist, Inspectorate (male and female) and—in charge of the vast nursing staff—a Matron-in-Chief.

It is a comfort and a help to feel that these many thousands of people—of medical and other professions, lay staff, nurses, engineers, domestics, clerks, porters and others—all work so well together as one team. The objective of sound administration is to guide without too much direction, to foster local initiative, to collect good ideas and pass them on, to leave experienced doctors to get on with their doctoring and not to interfere between any doctor and his patient.

Departmental committees.—When the Council knew of the vast services coming to it in 1930, it realized that to effect smooth transference of authority changes of procedure should not be too hastily made. Much preliminary work had been done and many conferences held, including meetings of medical superintendents, matrons and stewards, and it had been understood that any difficulty which might arise should be dealt with in exactly the same way as under the previous régime. A series of departmental committees (a sort of internal Royal Commission) was set up to deal with such matters as Hospital Standards, Maternity, L.C.C. Pharmacopæia, Pathology, Forms and Records (this committee instituted the interesting system of statistical work by mechanical tabulation with "Powers"-cards), Ambulances, Supplies, Staff, Economy(w). This valuable depart-

mental committee system, which is only possible in a large service, still continues.

Admissions.—Admissions to the general hospitals are now mostly on the sole authority of the medical superintendents with or without a medical certificate, or on an order by the Medical Officer of Health. The admissions by relieving officers' orders (the old Poor Law method) decreased from 54,500 in 1932, to 7,000 in 1937, whereas patients admitted by the medical superintendents increased from 72,000 to 155,000(x). This sheds a great light on the rapidly changing nature of our hospitals -from Poor Law infirmaries to general municipal hospitals. Another point for notice is the doubling (20,000 as compared with 10,000) in the number of births-showing how more and more mothers of London are using our maternity wards. In 1938 the births were 21,147. In 1937 35% and in 1938 37% of all births to mothers resident in the metropolis took place in the Council's general hospitals. The fever hospitals admit all types of fevers; the general hospitals admit everything-in fact, the L.C.C. hospital service may claim that it presents "the ever open

Classification of patients is of primary importance and a large hospital service gives ample opportunity for this. Not only are the hospitals themselves classified into-acute, chronic, convalescent, fever, tuberculosis, &c.-but there are many special units, e.g. in addition to those previously mentioned, for deep X-ray and radium therapy, fractures,

rheumatism, diabetes, gastric cases, ophthalmic cases, chest surgery, &c.

The chronic sick, including the bronchitic, the cardiac, the patients with inoperable cancer, &c., and the enfeebled aged, are patients practically wholly confined to bed, requiring daily medical or nursing attention. Although 3,500 of our chronics have been evacuated we still have about the same number under our care—3,500 was the pre-war figure. From the point of view of training both doctors and nurses there is much to be said for a "chronic" department in an acute hospital, but unfortunately such patients are not regarded as of great interest. The Council has a few hospitals occupied solely by the chronic sick. Perhaps the compromise of a large "acute" hospital with one or more "chronic" blocks or sections is the best solution—and indeed that is what we do in many instances.

The care of the chronic sick(y) constitutes a serious problem for the municipalities and one which the voluntary hospitals (except for one or two places like the Putney Home

for Incurables and the Birmingham Jaffray Hospital) have never tackled.

The infirm are persons normally able to get up and use day rooms but who require help in dressing, &c. These are dealt with in the Social Welfare Committee's "institu-

Healthy orphaned and derelict children under 3.-These fall to us to be dealt with and are catered for in "nurseries". At 3 they go to the Education Department's Resi-

dential Schools. (They are practically all now evacuated to the country.

Mental.—There are "observation units" at four hospitals--one, St. Pancras, recently opened, with the latest improvements. These observation units are peculiar to municipal hospitals and are part of the machinery of the Lunacy Acts. We have also three

psychiatric out-patient clinics, run by specialists from the mental hospitals.

Education of children in hospital(z).—The late M.A.B. always recognized the importance of the education of children in its hospitals. They were "long-stay" hospitals and the fact that a child is physically or mentally handicapped makes its education all the more There were commodious, specially built school buildings at some of the children's hospitals just like an ordinary elementary school. If the children could not get to them, the teachers went to the wards. Now the education department of the Council provides the teachers and the equipment, and a first-rate education adapted to the needs of the children is given. Scholarships are awarded to suitable pupils. The Board of Education has since "certified" these schools under Part V of the Education Act, 1921, and they qualified, in consequence, for educational grants.

Rehabilitation of adults is on a par with the education of children-both are intended to enable the patients to become self-supporting citizens. Unfortunately rehabilitation

has not yet received the attention it deserves.

Medical research(a).—The L.C.C. hospitals, with their 72,000 beds, offer a vast clinical field for medical research and every advantage is taken of these unique opportunities. There are two Clinical Research Committees from our own staff and of course there is a great deal of individual research work done as well(b). Facilities are given for clinical trials of new therapeutic substances and for access to types of rare cases to those writing The Rockefeller Foundation has given generous help to the Central Mental Pathological Laboratory of the Maudsley Hospital.

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Names of hospitals.—The Council has rechristened many of the general hospitals, giving them the names of Saints with local associations (e.g. Marylebone Infirmary became St. Charles' Hospital) or geographical names more appropriate to their position (e.g. Southwark Infirmary became Dulwich Hospital(c)).

Voluntary hospitals—arrangements, and co-operation, with(d).—Consultation on questions of new accommodation, &c., with representatives of the London Voluntary Hospitals is required by Section 13 of the Local Government Act, 1929. The "London Voluntary Hospitals Committee", constituted by a body representing the King Edward's Hospital Fund, the Conference of Teaching Hospitals, and the British Hospitals Association, was appointed to act for the London Voluntary Hospitals. The Act imposes no obligation on the voluntary hospitals to consult the Council (the duty is unilateral on the Council only) nevertheless consultation is mutual, amicable and productive. One of the first decisions reached was that grants to the voluntary hospitals by the Council should be for specific services rendered only and not in the form of contributions to the general funds of the hospitals.

In 1932-3 a "Joint Survey of the London Voluntary and Municipal Hospitals" was prepared(e) giving detailed statistical information, with maps, of the use made of the London hospitals. The interesting fact emerged that whilst the municipal hospitals are almost entirely occupied by inhabitants of the administrative County of London (only comparatively few "out-county" cases come in under special arrangements), the London

voluntary hospitals in 1931 admitted 40% from outside the county boundary.

Building works at the hospitals(f). Planning and development, &c.—It will be realized that—in addition to work dealing with equipment, staff, classification and co-ordination—very much thought, time and money have had to be spent on the actual buildings of the hospitals, new structures, repairs, reconditioning, &c. Not only have urgent works been carried out as required but a plan was formulated spreading further necessary works over a period of years. The war has put an end to the carrying out of this plan. It is hoped

that it will be implemented when peace returns.

There are three reasons why the volume and variety of works completed and contemplated were so great: (i) The backward condition of many of the hospitals in whole or in Their shortcomings, in one hospital or another, extended to every compart in 1930. ponent part of a hospital and included deficiencies of all kinds, overcrowded wards, out-of-date or absent ward washhand basins, dreadful sluice rooms, poor ward kitchens, inadequate hot water supply, heating, lighting or telephone systems and lifts, insufficient and poor staff accommodation, &c. (ii) The rapid progress made in every branch of medical science which has coincided with a like advance in the engineering, architectural and other sciences. There has, therefore, been need for a progressively greater and more complicated provision of medical equipment with its necessary accommodation and the demand for a better type of hospital building. (iii) Natural decay and the normal effects of wear and tear, particularly as long notice of their demise was given to the former authorities and some, naturally, did not proceed with developments which they otherwise might have done. The number and extent of the buildings are enormous and the repair and replacement required in any one year considerable. The main factor determining the need for expenditure was age, some parts of the buildings being more than a century old. It must, however, be pointed out that some of the hospitals transferred to the Council were in excellent condition.

Voluntary workers.—Apart from the voluntary services of members of the Council and of the hospital committees, much help is received in our hospitals from voluntary workers of all kinds. They include boy scouts, girl guides and, since the war, members of such bodies as the Women's Voluntary Services, the Order of St. John and the British Red

Cross Society, which has always managed the hospital libraries.

Rheumatism.—The Council has a scheme for the treatment of juvenile rheumatism for which there are special units at Carshalton, Brentwood, Norwood, Sutton and Dartford. At St. Stephen's Hospital there is a special unit with beds for adult patients. It works in close association with the British Red Cross Clinic, Peto Place, and the St. John Clinic, Ranelagh Road. Special treatment which the Council cannot provide in its own institutions is given where necessary. For example, patients requiring spa treatment are sent to the Royal Mineral Water Hospital, Bath, and St. John's Brine Bath Hospital, Droitwich.

Convalescence.—In addition to our own convalescent hospital facilities (in 1938, 3,164 men were treated at Queen Mary's, Sidcup, and 1,534 women at Margate (Princess Mary's) ) patients recommended for seaside convalescence are sent to voluntary seaside convalescent homes—for example, mothers with babies to the St. Mary's convalescent home, Dover.

Patients with symptoms of neurasthenia or other mental disorders are transferred to the Lady Chichester Hospital, Hove, or to one of the many homes of the Mental

After-Care Association.

Amenities for patients.—The Council provides in its hospitals: Chapels or devotional rooms (well equipped and decorated) and chaplains, ministers and religious instructors of all denominations—some of the chapels are very beautiful buildings, particularly that at Queen Mary's, Carshalton—libraries, newspapers and magazines, games, tobacco, sweets and toys (for children), flowers, materials for therapeutic occupational and recreational work, handicraft workshops and canteens. Clothing is also provided where necessary. "Samaritan" funds for financial help to patients, usually on discharge, exist at all hospitals. Their sources are donations and legacies and they are administered by the almoners. Gifts, sometimes substantial, are constantly being received from patients and their friends. Although our hospitals are rate-supported—and, therefore, need no extraneous assistance—these expressions of gratitude are welcome. Many are ear-marked for special purposes, e.g. "for the nurses" and these go into nurses' recreation funds.

Dietary.—The Medical Officer of Health has prescribed dietary scales for the various classes of patient. The doctor in charge can, of course, always order "extras" and special diets. The bringing in of food by patients' friends is discouraged. We employ trained and qualified dietitians and food supervisors and every care is taken to see that the meals

are served hot.

Subsidiary services and activities(g).—The following are amongst the supplementary

services provided:

Dental: Every hospital, including the mental hospitals, has a dental surgeon who attends in accordance with requirements. There are eight whole-time and some twenty-eight part-time. As an experiment to determine whether the service should be extended, whole-time dentists have been appointed to each of two hospitals. They are required to examine the teeth of every patient and provide treatment for all whose illness has been caused or aggravated by dental trouble. Ante-natal patients receive special attention. Dentures are made at our central dental laboratory. In 1937, 13,152 in-patients and 10,427 out-patients received dental treatment. This involved the giving of 10,000

anæsthetics, and the provision of 1,500 dentures.

Maternity: Great advances have been made—300 beds added (making 1,000)—anteand post-natal clinics developed. In 1937, 21,150 women were seen at 23 ante-natal clinics (132,270 attendances). There is full co-operation with the Borough Councils' Maternity and Child Welfare work. Necessitous expectant mothers receive extra nourishment. The Council also provides a Domiciliary Midwifery Service, employing directly 75 midwives, and under agreements with outside hospitals and nursing associations, 50 fulltime and 51 part-time midwives. In 1940, 14,138 domiciliary confinements were attended under these arrangements, but in 1941, owing to "blitzes" this number fell to 6,531. We maintain in the hospitals an emergency obstetric service, "flying squads"—doctors and nurses—who can be rushed to any difficult or urgent maternity case at any time.

Surgery: Existing operating theatres have been remodelled and new ones of the latest design built. The number of consulting surgeons engaged has been considerably increased and the theatre nursing staffs added to and improved. In the general acute hospitals (only) the number of major surgical operations under general anæsthetics was in 1931, 31,063, in 1937, 47,955. The Council's hospitals are being used increasingly for emergency

surgery.

Tuberculosis: All patients are dealt with under the Tuberculosis Scheme, which secures continuity of service and treatment through its very great resources (dispensary, hospital, sanatoria). In the general hospitals there are some 1,000 beds used for non-ambulant patients unsuitable for sanatoria, and for emergency and observation cases. 2,186 beds in L.C.C. tuberculosis hospitals and sanatoria and 1,345 in voluntary institutions are used.

Venereal disease: The Council acts as Manager of the London and Home Counties Scheme. It maintains the Whitechapel Clinic, the largest in London, and the Endell Street Clinic; and subsidizes 16 clinics at voluntary hospitals. Children are sent to the Waddon Country Home. There is a special hospital for maternity cases infected with venereal disease and a special unit for children so infected. There are wards set aside for the treatment of V.D. patients in certain general hospitals. Everything is done with the co-operation of religious and social workers, for the assistance, rehabilitation and after-care of female patients. Trained instructresses attend to teach them handicrafts, needlework, &c.

X-ray and physiotherapy: These are needed more and more in a modern hospital and our hospitals have not fallen behind. All have X-ray and massage departments with

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trained radiographic and massage staff. There were over a million attendances in these departments in 1937—more than twice the number in 1931. Deep X-ray and radium treatment of cancer is provided at Lambeth and Hammersmith hospitals.

Other items which may be of interest are:

Adoption of children: The work connected with the adoption in suitable cases of orphaned, &c., children by approved applicants under the Adoption of Children Act, 1926, is done in the Public Health Department.

Lady almoners: A large staff now employed on social and charitable work and the collection of maintenance charges, &c.

L.C.C. Ambulance Service: 20 stations, 400 staff, 200 ambulances (pre-war: vastly expanded now).

Charges to patients(h): Patients pay what they can, but fever, smalipox, T.B., V.D. and E.M.S. patients are treated free.

Consultants and specialists: The consultants' panel—pre-war—contained 250 names—the appropriate consultant being available at any time at any hospital.

District medical and nursing services: The council's continuation of the old "parish doctor" system—work now associated more or less closely with the general hospitals. A large subsidy is paid for district nursing.

Farms and gardens: Most hospitals, especially those outside the central area of London, have gardens—some very beautiful (Carshalton, Heatherwood, Dartford). At many, especially the mental hospitals, there are farms under bailiffs and trained staff. Farm work is a therapeutic measure at some. In view of the national effort in food production, a central Farms Committee has recently been set up. The total area of farm land is now 6,000 acres. There are 1,530 cows, 1,630 sheep and 3,600 pigs.

Hospital finance(i): A complicated subject, but we must say that costings are an essential part of the work of an efficient hospital system. Costings often show that apparently the same processes or procedures cost twice as much at one hospital as at another. Extravagance or economy (without loss of efficiency) are often habits of mind and the latter can replace the former once the facts are known. Running hospitals is "big business" and business methods must, to the extent appropriate, be applied.

Laundrywork is done in the hospital laundries with a few exceptions, where it is done by contract. Some 70,000,000 articles are washed yearly. An expert on laundrywork has been appointed.

Medical (under- and post-graduate) and nursing education: Facilities for London medical students in general and obstetric work, fevers and mental cases—various post-graduate facilities—the British Post-Graduate Medical School at Hammersmith. L.C.C. hospitals are training schools for all groups of nurses—general, children's, fever, T.B., mental, and male.

Out-patients: Departments at all general hospitals. In 1937 nearly one million attendances.

Pathology: A complete service—group and hospital laboratories and a serum institute. Staff: General and special hospitals: total 21,000 including medical 760, nurses 11,000, clerical 500, domestic 9,000. Mental health services total staff is 12,000.

Supplies: Annual cost of supplies £4,000,000—Food, £1,500,000—Medical and surgical supplies, £300,000—all standardized.

# A FEW COMPARISONS BETWEEN VOLUNTARY AND MUNICIPAL HOSPITALS

(k)An essential difference is that a Voluntary Hospital is an individual unit. It prides itself on its individuality and freedom from control. A hospital service, particularly a large one with a statutory duty to provide for the inhabitants of its district, fits individual hospitals into a co-ordinated scheme. A service has to provide the best treatment for everyone who applies. It cannot have any gaps. It cannot say "We have no bed for you". Moreover, it can specialize and thereby provide the highest skill and the best equipment for unusual and particularly complicated or expensive forms of treatment. In a service there is "free trade" in information—the good ideas of the individuals

forming the team are passed to all the other members. There are frequent conferences and discussions at which ideas are pooled. Experts in specialized forms of treatment and in the specification (often involving long research into the best design) and the purchase of supplies, in hospital engineering and architecture, can be provided for a service, on a scale which could not be justified for individual hospitals. The ideal is to retain individuality and freedom to try experiments and improvements in the separate institutions of a service but to give them also the benefits of team work and combined experience.

The King Edward Fund, the British Hospitals Association and the Nuffield Trust form links between individual voluntary hospitals, but they cannot weld the individual hospitals into a service.

The systems of administration are not so different as is sometimes thought. In both voluntary and municipal hospitals the management is in the hands of public-spirited people who are giving their services to the community free of charge. But there is this difference, the managers of municipal hospitals are responsible to the ratepayers who elect the members of a Council and the members can be turned out at the next election if the public are dissatisfied with the services rendered. As a consequence complaints are regarded very seriously. Voluntary Hospital Committees have to run no such gauntlet. Vacancies on the Committees are filled by co-option. They are responsible to the subscribers and to their consciences, but the patients for whom the services are provided have no votes and cannot elect a new Committee.

There are differences in the methods of staffing municipal and voluntary hospitals which need not be described in detail. Both systems have their advocates but there are indications that they will tend to approximate more closely to each other as time goes on.

Sir Henry Burdett in "Hospitals and Asylums of the World" (1893) pointed out the differences, at that time, between voluntary hospitals and Poor Law infirmaries (municipal hospitals); to-day these "differences" have been modified or removed entirely(l). The majority of patients in the infirmaries are no longer "chronics" as they were in Burdett's time. The L.C.C. hospitals now do an enormous amount of acute work—and their equipment is as good, if not in many instances, better than in any voluntary hospital. The infirmaries had no out-patient departments. All L.C.C. general hospitals have such departments—many doing very heavy work. The infirmaries could not get rid of an unwanted patient. This is still true if the patient is medically destitute. Burdett also mentions there are "no Medical Schools", which is, again, still true, though the Medical Schools are relying increasingly on the Council hospitals for clinical material, especially in obstetrics. He says "Classification is bad". It is now good. "Guardians are loth to spend money." This is a fair accusation but cannot hold in the case of the L.C.C. "The County Councils should 'take over'." This was done in 1930. "The infirmaries have no honorary medical and surgical staff"—but the Council has a very complete staff of paid consultants. It has often been pointed out that whilst voluntary hospitals have to solicit the public for funds, municipal hospitals are relieved of anxiety by their power to levy a rate(m).

# SOME OF THE IMPROVEMENTS EFFECTED BY THE LONDON COUNTY ${\tt COUNCIL}(n)$

The Poor Law infirmaries of fifty years ago provided food and shelter for their patients; but their skilled staff and equipment were so meagre that they could only provide in very small measure the services of medicine and surgery which were available at that time. The medical staff of even the largest institutions consisted only of a medical superintendent and—in some cases—a deputy. Paid nurses were hardly employed at all and only in very small numbers. The training of probationers had been initiated in a few, but much of the nursing was still done by pauper inmates. There was but scanty provision of medical and surgical equipment, none for any special form of treatment, and no operating theatres. There had been great developments before 1930 but from the outset of its control the L.C.C. has pursued a policy of progressive improvement in every direction and in every hospital coming under its charge. Its aim was to raise them all to the highest modern standard, and although this was a formidable task and all its plans have not yet been completed, a great deal has been achieved, and the result is seen in the hospitals as they exist to-day. The depressing conditions of the past have been replaced by cheerfulness and comfort. Everywhere the ward walls

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are now decorated in attractive colours; central heating and modern lighting have been provided, and many open-air balconies have been erected. Under other headings we have referred to the great increase in the quantity and quality of the work carried out in the Council's hospitals, and reference to the statistical tables contained in the annual reports (those dealing, inter alia, with operations, out-patients, physiotherapy, massage, maternity, X-ray work, convalescence, dental work, number of staff, and so on) shows how the work carried out has, since the Council took it over, multiplied in some cases fourfold.

The Council has issued since 1930 a series of annual reports dealing with its hospitals, which to anyone interested in the subject, are mines of information.

Views of the Ministry of Health.—In its Annual Report, 1934-35(o), the Ministry says: "The effects of the Local Government Act on organization have nowhere been more strikingly illustrated or on such a great scale as in London. To achieve the great advances made, unified control from the beginning and a single head (the County Medical Officer of Health) were essential." Sir Kingsley Wood, the Minister, added: "London (whose area, population and resources exceed those of not a few sovereign states) provides an example and an encouragement as to what may be achieved in the development of public, medical, institutional and welfare services."

The L.C.C. Mental Hospitals.—These fall into two classes (i) those (originally "lunatic asylums") belonging to the Council on March 31, 1930, and (ii) those nostly for imbeciles and feeble-minded transferred from the M.A.B. on April 1, 1930. (This transfer permitted similar classification and unification as in the case of the other hospitals.) There are 22 mental hospitals (temporarily 24) with over 34,000 beds. Until County Councils were formed (under the Local Government Act, 1888) the provision and administration of county lunatic asylums was the duty of the Justices. Hanwell (now St. Bernard's Hospital) was the first, in 1831. It was here that "The Retreat (York)" humane methods superseded the "restraint" (handcuffs, muffs, leg-irons, &c.) formerly in vogue. Colney Hatch (Friern Hospital) followed in 1851, and then the others. The Mental Deficiency Act, 1913, separated and specialized the care of the mental defective and there are four hospitals exclusively for this class: Manor, Farmfield, Brunswick House and Southside.

Maudsley Hospital (largely the gift of Dr. Henry Maudsley, a distinguished alienist) is for patients with a good chance of recovery and is an important research centre in psychiatry. It received "voluntary" and "temporary" patients fifteen years before the Mental Treatment Act of 1930. It has two University of London Chairs—in clinical psychiatry and mental pathology.

St. Ebba's: A "villa" hospital for recoverable patients.

Horton: Here is concentrated the treatment of general paralysis, &c., by malaria therapy.

The mental hospitals have surrendered (by overcrowding mental patients) 7,800 beds to the Emergency Medical Service for air-raid casualties, &c.

The Council has recently recognized the importance of treatment as distinct from detention in mental hospitals by transferring their management to the Public Health Department.

## THE WAR

As a result of war-time restrictions building developments have been suspended. Unprecedented demands on our beds have been made and met. Staff, both at the County Hall and in the hospitals themselves, have left for, or been called to, H.M. Forces. Key staff have been seconded to Government Departments and expansion and progress in practically every direction have been either stopped or considerably curtailed.

Air-raid damage to hospitals.—From the commencement of the air raids on London in September 1940, to their cessation in May 1941, air-raid "incidents" occurred at our hospitals. These hospitals included all those within the administrative County of London and the damage ranged from that of a slight nature (windows and roofs damaged by blast) to total destruction of large parts of hospitals which necessitated their complete closing while repairs to vital equipment such as operating theatres, kitchens, laundries and boiler houses were carried out. Repairs were put in hand immediately wherever practicable and by March 1942 much accommodation had been brought back into use. Compared with the extent of the damage and the number of incidents the casualties among patients and staff were fortunately small. We would pay a sincere tribute to the bravery and devotion to duty displayed by our hospital staffs during these "blitzes".

Doctors and nurses and all grades "carried on" in a magnificent manner. Many have been decorated for their gallantry, but many more performed deeds of quiet and unnoticed beroism, and a sense of vital duty well and nobly done without ostentation is their only reward.

The War Emergency Hospital Scheme of the Ministry of Health is a hospital service in which the L.C.C. has played its part—the details of which cannot be considered here.

We have endeavoured to make this paper factual only and have repressed any inclination to express opinions. If any of our statements can be regarded as opinions they are our own and not (necessarily) those of the County Council. It is tempting to forecast the future but time will not permit(p). Suffice it to say that the L.C.C. Service shows what an organized hospital service under public control can do.

It has been stated that the four main functions of a hospital are: (1) To cure the sick; (2) medical and nursing education; (3) investigation and research; and (4) disease prevention. We are trying to do all we can in all four directions.

We would like here to pay a warm tribute to the work of Sir Frederick Menzies whose vision and wise leadership made possible the progress which we have endeavoured to outline.

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## JOINT DISCUSSION No. 5

## Sections of Ophthalmology and Neurology

Chairman-A. J. BALLANTYNE, M.D.

(President of the Section of Ophthalmology)

[February 13, 1942]

## DISCUSSION ON WAR INJURIES IN RELATION TO OPHTHALM-OLOGY AND NEURO-SURGERY

Mr. Frederick Ridley: In 1915 the Ophthalmological Society of the United Kingdom held a discussion on war injuries. Hysterical blindness and blepharospasm, functional night-blindness, the fact that hypermetropia often becomes wholly manifest under the stress of active service, and papillædema, were discussed and the observations are of importance to-day. Lister drew attention to the fact that increasing papillædema is of more importance than the observation of papillædema per se. Even now this is not sufficiently recognized and our current clinical notes do not, as a rule, indicate clearly the degree of papillædema. It would be helpful to the neurologist and to the ophthalmologist if every case were described as "doubtful", "definite", or "gross". Too often, under war conditions, the full notes of disc appearances and measurements of swelling do not travel with the patient but, if the appropriate adjective were always coupled with the diagnosis, change in degree of papillædema, which is all important, would be apparent.

The following groups of cases have been selected as being either unusual in civilian practice or as having proved of common interest to my neurological colleagues and to myself. All were observed in the course of work under the Emergency Medical Service.

### GROUP 1

Diplopia due to displacement of the eye.—Displacement of the eye as a result of fractures of the orbit associated with great violence is not uncommon, especially when the fracture involves the middle third of the face. The eye is often proptosed for several days owing to orbital hæmorrhage and ædema. Later the eye is displaced, usually downwards, and enophthalmos may be observed. The patient complains of diplopia, this may be confusing unless the displacement of the eye is recognized. It rarely simulates a typical oculomotor nerve palsy. In many cases there is only a small field of single vision. Treatment consists of orthoptic training assisted in many cases by operation.

Diplopia due to local injury to muscles.—Local injury, especially that due to lateral blows on the head, often gives rise to direct bruising and paresis of the external rectus muscle, with diplopia. Later on limitation of movement of such an injured muscle may be permanent. In either case the condition may be confused with a 6th nerve paresis.

### GROUP 2

Direct injury to the eye.—Commotio retinæ is often seen and may complicate the diagnosis if papilloedema is suspected. Traumatic mydriasis has been observed many times. It may be confusing in a patient admitted unconscious following a severe head injury. There may be local injury, the pupil is not fully dilated and its size does not alter. Traumatic mydriasis may result in a permanently non-reacting semi-dilated pupil, which may complicate subsequent neurological diagnosis.

Indirect retinal changes.—Two types of traumatic retinal angiopathy are described. Purtscher (1910) described multiple glistening white areas,  $\frac{1}{5}$  to  $\frac{1}{2}$  disc diam. scattered over the posterior pole of the eye and situated in the inner layers of the retina, following

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compression injuries of the head or thorax. Small preretinal hæmorrhages and a mild cedema of the disc may also occur. Recovery without residual scarring is to be expected within one week. Wagenmann described a second group in which small hæmorrhages in the inner retinal layers about the posterior pole occur without the patches of œdema. This is the characteristic appearance in retinal hamorrhage of the newborn. Two cases of this type were seen. One was a young man who was involved in a bomb explosion. No history was available but the retinal appearance led to the discovery of a deep bruise about four inches long above and parallel to the clavicle on the affected side. It is possible that he had lain with his neck over a bar of some kind or had fallen across such an obstruction. The case is of interest as an unusual type of retinal hæmorrhage and is perhaps unique in being due to unilateral obstruction of the great veins at the base of the neck. A second similar case was seen in a patient who received a gunshot wound in the occipital region and developed extensive hæmorrhages involving the inner retinal layers in both eyes. These hæmorrhages cleared up within seven days. This case may belong to a third group or may be classed with retinal angiopathies due to compression of the head, in which the pathology of the retinal hæmorrhages is obscure.

### GROUP 3

Direct injuries to the optic nerve.—One case in this group, a penetrating wound of the left orbit dividing the optic nerve, was of interest in that optic atrophy and narrowing of the retinal arteries was seen only twelve days after the injury. This is the earliest onset of optic atrophy I have seen; one other showed atrophy at seventeen days. The majority have been observed at the recognized interval of three weeks after injury.

Indirect injuries to the optic nerve.—This note is an abstract of a series of such cases reported by Dr. J. W. Aldren Turner.

Twelve cases of this type were observed in a series of 450 head injuries admitted to an E.M.S. Centre. In 11 cases the injury was frontal, often somewhat lateral, and in one parietal. In two patients the injury was a minor one: in four there was loss of P.L. the others ranging from  $\frac{\theta}{0}$  to hand movements. Field loss was variable, always involving constriction of the peripheral field, three showed central defects with steep edges, three showed large sector defects, two involving the fixation point. Recovery may be seen up to four months but is rare subsequently. Progressive deterioration for several months is often recorded. Pallor of the disc within seventeen days was observed but three weeks is the rule. The pupillary response is sluggish but the normal consensual response distinguishes it from the Hutchinsonian pupil. The pupil is not dilated save in complicated cases. Complications included three cases of cerebrospinal rhinorrhoa, three of anosmia and one 3rd and one 6th nerve palsy.

In all twelve cases stereoscopic X-rays showed no fracture involving the optic foramen or canal. The lateral character of many of these injuries and the fact that several were of minor severity does not support the theory of antero-posterior deformation of the skull as the cause of these injuries. Damage to the optic nerve is probably due to a vascular lesion in the sheath or in the nerve substance as has been suggested in lesions of the chiasm. Mr. Ridley has suggested that the blow is transmitted by the skull directly to the optic nerve which is firmly fixed in its canal, and which is thus displaced sharply backwards while the loosely supported globe is "left behind". As the eyes will often be looking towards the direction of the blow the optic nerve will be relatively on the stretch at the moment of impact and the optic nerve at the foramen will thus be sharply snatched and the vessels in the sheath or nerve substance may be torn. Occlusion of the central artery of the retina occurs in similar injuries and may be due to the same mechanism.

### GROUP 4

Visual field changes in penetrating wounds of the vault.—This group has provided many cases of interest but few that might add to our knowledge. Aphasia, alexia and hemiplegia have been observed in association with homonymous hemianopia but the order in which recovery has taken place and the site of injury have rarely presented a clear-cut clinical picture.

One case (S. E.) who suffered a gunshot wound, the fragment entering in the left occipital region and lodging in the right posterior parieto-temporal region, is of particular interest. The fragment passed through the left visual cortex just in front of the pole, the macula and about five degrees around being spared, and passed upwards and forwards with low velocity, passing through the right outci radiation. The right field defect is a typical hemianopia with sparing of the macula (fig. p. 47). The left field defect shows peripheral loss and is unusual in that the nasal field of the right

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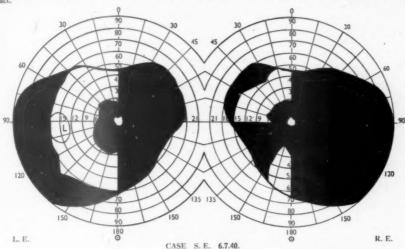
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eye is not congruous, being divided by a large blind area which has a clear-cut horizontal axial border. This may be regarded as an incomplete quadrantic defect. The left field is characteristic of injury to the right optic radiation, or tract.



In this case the fragment could not have involved the tract and, in spite of the incongruity, the lesion must be situated in the right optic radiation. The incongruity was confirmed by repeated examinations and lends support to the possibility, hitherto lacking satisfactory clinical evidence, that the fibres from the two eyes may not be completely mixed at this level.

Dr. W. Russell Brain: Out of 528 consecutive cases of head injury, almost all closed injuries, seen on an average ten months after the injury, only 53 patients, or 10%, showed any ophthalmological symptoms, as follows:

Ophthalmoplegia							96	cases	5.0%	of.	total
				000	***	0 = 0		Cascs			
Pupillary abnormaliti	es	***	***	***	***	***	15	99	2.8%	33	22
Nystagmus	888	***	***	***	***	***	10	39	1.8%	33	99
Ptosis		***		***	***	***	6	22	1.0%	22	22
Injury to optic nerve		***		***	***	***	5	22	0.9%	22	99
Homonymous visual							- 5		Destant.		29
Disorder of higher vi							- 6	39	Techto.		

Ophthalmoplegia may be caused by an injury either (i) in the orbit, (ii) between the orbit and the brain-stem, or (iii) in the brain-stem. (i) In at least 9 of the 26 cases of ophthalmoplegia the injury was in the orbit. Orbital injuries may involve only a single muscle, especially one of the obliques, and the ocular palsy is often associated with evidence of bony injury to the roof or floor of the orbit and coincident damage to the supra-orbital or infra-orbital nerve. (ii) In 13 cases the lesion appeared to be between the orbit and the brain-stem. This group included 9 out of the 10 cases of unilateral external rectus palsy. There were three cases of complete or partial 3rd nerve palsy, one due to traumatic aneurysm of the carotid and cavernous sinus. (iii) There were only four cases in which persistent ophthalmoplegia was due to a lesion of the brain-stem. In 3 of the 4 cases the ocular movement lost was conjugate convergence, which in one was associated with weakness of conjugate elevation.

Pupillary abnormalities were present in 15 cases. Apart from the 3 cases of 3rd nerve palsy and one case of subdural hæmatoma, the lesion appeared to be in the mid-brain. Inequality of the pupils is the commonest abnormality, but the difference in size is not usually great: the larger is usually the abnormal one. Either the reaction to light or that to accommodation may be sluggish, and on one or both sides, but in my experience it is rare for both to be affected together. Iridoplegia is thus a commoner persistent symptom of mid-brain damage than ophthalmoplegia.

Ptosis is more unusual, and, apart from 3rd nerve lesions, was found in only 4 cases and then was only slight.

Nystagmus was present in 10 cases: in 8 cases it was interpreted as a symptom of mid-brain damage: in the other two a rotary nystagmus to one or both sides was of vestibular origin, and was associated with deafness resulting from injury to the internal ear.

As in the case of ophthalmoplegia of mid-brain origin, iridoplegia, ptosis and nystagmus all tend to disappear within a rew months of a head injury. The prognosis of ophthalmoplegia due to lesions between the brain-stem and the orbit and in the orbit itself is more uncertain. Certainly recovery may occur with either, but is unlikely to be complete when the initial paralysis is severe, when there is much deformity of the orbital wall, or when ophthalmoplegia is still present six months after the injury.

### INJURIES INVOLVING THE VISUAL PATHWAYS

Papillædema is not uncommon in the acute stage of head injuries and is probably a symptom of increased pressure of the cerebrospinal fluid. It appears almost always to subside completely without any impairment of vision and it is very rare to see even slight secondary optic atrophy in the victims of a head injury.

Direct injuries to the visual pathways occurred in 10 cases in this series; just under 2% of the total. In 5 cases the optic nerve was injured. The cause, as Traquair (1931) suggests, is probably the rupture of vessels passing from the sheath into the nerve substance.

Traumatic lesions of the optic chiasma appear to be uncommon or at least not commonly recognized. Traquair, Dott and Russell (1935) discovered 27 cases in the literature and added three of their own, two in 450 cases of head injury. The visual fields resemble those found in cases of compression of the chiasma by a tumour, and these authors believe that the lesion is not a direct tear of the chiasma but a vascular injury.

In 5 of my cases there was a visual field defect of homonymous distribution, but in none was the hemianopia complete. In 3 the lower quadrants suffered more than the upper, and in one the defect was limited to the lower quadrants. Homonymous field defects are thus uncommon after closed head injuries. Penetrating injuries of the optic radiation usually produce a complete hemianopia or large irregular areas of blindness, but quadrantic or other regular defects may occur.

## THE PARIETO-OCCIPITAL CORTEX AND THE HIGHER VISUAL FUNCTIONS

The importance of vision in every sphere of human activity has led to an extremely complex organization of higher visual functions which depend upon the integrity of the parieto-occipital region or visuo-psychic area of the brain. The following is a brief classification of the principal disorders of the higher visual functions, from some or other of which 6 patients in this series suffered.

(1) Alexia: This was present in 4 out of the 6 cases, in varying degrees of severity.(2) Visual object-agnosia: This was present in the early months after the injury in

(3) Loss of topographical memory: This was present in two patients who in consequence

(3) Loss of topographical memory: This was present in two patients who in consequence were unable to describe their houses, or find their way about.

(4) Loss of visual imagery: In one case this was the sole sequel of a severe head injury. The patient five years later is completely unable to form any visual picture. He cannot visualize his wife or his house or any familiar object, and though he still dreams he no longer dreams in visual images.

It is probable that all the foregoing disorders are related to cerebral dominance and only occur as a result of left-sided lesions in right-handed persons.

(5) Defective visual localization in space, on the other hand, may be limited to either half-field as a result of a lesion of the opposite parietal lobe (Brain, 1941). It is characterized by an inability to appreciate the absolute and relative position of objects seen, especially in relation to the patient's sagittal plane. This was present in 2 cases. Bilateral lesions cause a much more severe disturbance than unilateral ones. Defective visual localization leads to misdirected grasping and pointing and disordered ocular movements.

(6) Visual inattention, present in one case, may similarly be limited to one half-field.
(7) Finally, there is one disorder which I mention for completeness, although I have seen no traumatic example of it: inattention to, or agnosia for one-half of space. This has been observed as a result of lesions of the right parieto-occipital region only and is usually, but not invariably, associated with a left homonymous hemianopia. Imperception of the left half of space, which is a more profound disturbance than merely a hemianopia, leads to one form of visual disorientation (Brain, 1941).

Disorders of the higher visual functions are likely to occur only with severe head injuries. Though gross confusion may last for weeks, improvement continues for many months, but recovery is never complete.

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Mr. Wylie McKissock: The necessity of closer collaboration between ophthalmologist and neuro-surgeon has become more evident in time of war, for the orbit and its contents, together with the intracranial visual pathways, form a common territory for the specialists in these two branches of surgery.

Many cases of war injury involve both orbital and intracranial contents and require the services of both specialists for their adequate treatment. Believing, as we do, that there is no great urgency in the excision of wounds involving the skull and its contents there is always ample time to achieve the necessary combination of specialists who should,

in many cases, operate together.

An attempt to produce a clear-cut classification on anatomical grounds of the possible varieties of injury to the visual mechanism has proved unsatisfactory; here is a simpler form of subdivision based largely upon the types of injury we have met: (I) Injuries involving the orbital contents alone. (II) Injuries involving the orbit and accessory nasal sinuses. (III) Injuries involving the orbit and the intracranial membranes. (IV) Injuries involving the orbit with penetration of the brain. (V) Injuries involving the visual pathway from the optic foramen to the occipital cortex.

I.—Injuries Involving the Orbital Contents Alone

The entire diagnosis and treatment of this type of injury naturally devolve upon the ophthalmic surgeon and it would be presumptuous of me to attempt to discuss them.

It should, however, be remembered that there may be an associated cranio-cerebral injury of the closed type. Many patients, therefore, with a wound of the orbital contents alone, especially if produced by blunt injury, where there has been a history of unconsciousness at the time of wounding should be referred to the neurologist or neurological surgeon for tull neurological examination, radiological investigation of the skull and lumbar puncture to determine the presence, degree or absence of associated closed injury to the brain or to its covering membranes. In the majority of cases showing evidence of intracranial damage the routine dehydration treatment of restricted fluid intake, rectal injection of magnesium sulphate and repeated lumbar puncture, designed to keep the intracranial pressure within normal limits, may well be carried out in the ophthalmic department with but occasional visits from the neurologist or neurological surgeon. The important point to remember is that such associated closed head injury may well be present especially in casualties from bombing.

II.—INJURIES INVOLVING THE ORBIT AND ACCESSORY NASAL SINUSES

Injuries to the orbit associated with an opening into one of the accessory nasal sinuses may be produced by blunt injury to the surface of the head or eye, by a penetrating wound of the orbit entering an accessory sinus, or by a missile passing through the skull and brain and thence invading an accessory sinus as well as the orbit.

brain and thence invading an accessory sinus as well as the orbit.

Of the first variety we have had one example (N.) in which a young man was struck by a fairly large piece of meta which fiew off a Diesel pump. The metallic object struck the head violently over the anterior surface of the left orbit but did not render the patient unconscious. He suffered almost immediately from severe swelling of both eyelids on the left side and extreme pain in the eye associated with vomiting. When examined he showed true emphysema of the orbit, proptosis of the left eye with marked chemosis, and some subconjunctival hæmorrhage. He had, in addition, a partial left anosmia and it was felt that he must have sustained a fracture into the ethmoid air cells which had permitted the extravasation of air into the orbital cavity. All movements of the eye were limited and extremely painful and there was diplopia but no external wound over any part of the head. After careful investigation there proved to be no evidence of associated intracranial injury and at the end of four weeks he patient was discharged well and symptomless but still with slight residual weakness of the left superior rectus muscle.

Of the second variety the following is a good example (E. G.). A very obese woman of 54, already blind in the right eye for many years, received an injury from flying pieces of cement entering the left eye, left inner canthus, and the root of the nose. The left eye was disorganized and a deep cavity existed over the bridge of the nose at the level of the glabella. It proved unfortunate for us that the patient had severe varicosities of the veins of each leg, a large brawny induration on the left leg from an old varicose ulcer and a dirty ragged wound of the left ankle. Twenty-four hours after the injury Mr. Goldsmith excised the left eye, after which, through a small scalp flap, we excised the whole wound. This involved opening and partially excising both frontal sinuses, the anterior and middle ethmoid air cells, and removing the nasal

The third variety of this type of injury to the orbit and to an accessory nasal sinus, by a missile entering the cranium from above, has not occurred in our series.

### III.—Injuries Involving the Orbit and the Intracranial Membranes

Foreign bodies or penetrating wounds of the orbit may impinge upon the deep boundaries of this cavity and the former may become impacted in the bony orbital wall, thus protruding into the subarachnoid space, or pass completely into the cranial cavity. Where the foreign body is comparatively small we have adopted an expectant policy and all cases where this course has been followed have, so far, given comparatively good results.

One case (M.) had a small bomb fragment which had entered the inner end of the left lower lid and become impacted in the wing of the sphenoid at the back of the orbit. The cerebrospinal fluid contained a moderate amount of blood and it seemed reasonable to suppose that this was due to damage to the covering membranes of the brain at the

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site of the foreign body. The left eye was completely disorganized and was removed by Mr. Goldsmith but the metallic toreign body was left untouched. The intracranial bleeding soon ceased and simple dehydration therapy proved adequate to control the intracranial condution. The eye socket healed well and rapidly. Seventeen months later the patient was alive, symptomiess and working.

The second case (C.) was essentially similar but here the foreign body, again a bomb fragment, passed through the back of the orbit and lay on the tip of the left petrous bone. This piece of metal nad entered through a very small opening in the left upper lid, disorganized the eye, and passed on. The patient did not come to us until some weeks after injury, when he was admitted for persistent neadache and numbness of the left side of the face, the left eye having been excised elsewhere. He proved to have complete paralysis of the left of the nerve and a partial left facial palsy. He was a poor specimen of the complaining, compensation-nunting type and it was left that excision of the foreign body, whilst proving extremely dimcult technically, would do little towards cure of the nearactness. No operation, therefore, was undertaken. Nine months later the patient was still under treatment for contraction of the left eye socket out had developed no serious intracranial complication from the presence of the bono fragment.

### IV .- INJURIES INVOLVING THE ORBIT WITH PENETRATION OF THE BRAIN

In this class of case the treatment depends to a great extent upon the nature of the wound and its mode of production. If produced by a small, high velocity, metallic fragment entering through the orbit and eventually becoming embedded in the brain there seems reason to believe that little need be done except for the local condition in the eye, if this has been damaged. Here is an example.

A young soldier suffered a wound from a small metallic bomb fragment which entered the outer end of the left lower lid, passed obliquely through the lateral half of the globe and then upwards through the roof of the orbit into the postero-inferior part of the left frontal lobe. The only surgical treatment carried out was excision of the eye by Mrt. Goldsmith, the wound track ocing left severely alone. Dehydration therapy and repeated lumbar puncture were instituted for relief of the cranto-cereoral wound. During the three weeks immediately following the injury there was an extensive cellular reaction in the cerebrospinal fluid and three pyrexial attacks at five-day intervals were associated with headache, photophobia and neck rigidity. After a course of M & B 693 the patient was working and in excellent general health. No complication would appear to have arisen as a result of the metallic foreign body lying in the frontal lobe.

At the other end of the scale is the patient in whom there has been gross damage to external tissues and gross penetration of bone and brain.

A woman of 35 (C. W.) illustrates this type of lesion very well. Part of the lath and plaster ceiling of her house was driven through the upper and inner part of the orbit and the inner end of the right supra-orbital ridge, destroying the right eye in the process. Some of the foreign bodies passed through the roof of the orbit from below upwards, coming inselly to rest in the substance of the right frontal ilobe. The right frontal sinus was fractured posteriorly and there was air in the substance of the right frontal ilobe. The right frontal sinus was fractured posteriorly and there was air in the substance of the right frontal ilobe. The right frontal sinus was fractured posteriorly and there was air in the substance of the right frontal ilobe. The right frontal sinus was fractured posteriorly and there was air in the substance of the right frontal ilobe. If he right frontal sinus was fractured posteriorly and there was air in the substance of the right frontal ilobe. I have also reconstituted and repaired the inner canthus, after which we carried out a complete excision of all loose bone tragments, damaged tissue and foreign bodies including many pieces of wood from the oran itself. I he curia openings were closed with sheets of tissue front the scalp and the wound was left widely open, being lined with gutta-percina tissue and then gently packed. This patient was discharged from hospital three months from the day on which she was injured and was tren symptomies and without abnormal physical signs in the central nervous system. She was subsequently operated upon by Mr. Mowlem who reconstituted her supra-orbital ridge, filled in the frontal bone defect and produce correct alignment of the eyebrow. At the present time, fourteen months after the injury, she is working, has no symptoms, and no ovolous facial deformity.

Between the two examples in this class which I have endeavoured to illustrate lie many intervening variations, each one of which must, of necessity, be treated on its own merits, but would appear to me to require continuous supervision by both specialists throughout the period of treatment.

### V.—Injuries Involving the Visual Pathway from the Optic Foramen to the OCCIPITAL CORTEX

Of the many possible injuries to the visual pathway from the optic foramen to the occipital cortex, with their attendant multiplicity of signs from total blindness through field defect to disturbance of visual memory and interpretation, we have had a few

scattered examples.

The many complications which may arise in the course of treatment of the type of injury which I have been discussing are all too obvious. The threats of sepsis from the initial injury and from hospital infection of the operation wound, hang over us perpetually. The advent of the sulphonamides has done much towards prevention, as well as cure, of sepsis in its many forms but nevertheless the risks of meningitis, of osteomyelitis of the skull and of local abscess formation still exist. I believe that dusting of the post-operation wounds with sulphonamide powder may do much to prevent the development of such infection in its early stages and I have now adopted it as a routine measure.

One of the many points upon which I would like advice is that of the ultimate fate of these small metallic foreign bodies which pass through the orbit into the brain substance, which would prove extremely difficult to remove surgically and, on removal, would inevitably produce more brain damage than was already present. So far not one of our cases has fallen a victim to a brain abscess developing at the site of such a foreign body but the

possibility of this development is a very real one.

The scarring around such foreign bodies and along the track of their entry may later give rise to a pull on the cerebral cortex, to traction diverticulum from the ventricular system and the subsequent development of traumatic epilepsy. Here again the investigation of such late sequelæ as brain abscess and traumatic epilepsy provides further opportunities for our ophthalmic associates, to aid us in the accurate localization of these lesions through the medium of the visual field defects which may occur.

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# Section of Orthopædics

President—C. LAMBRINUDI, F.R.C.S. [June 13, 1942]

Meeting at R.A.F. General Hospital

# REHABILITATION IN ORTHOPÆDIC CASES

In the course of a ward visit, the work of clinical secretaries, clinical photographers, radiographic printers, and rehabilitation orderlies was demonstrated. Patients with limbs immobilized in splints, in traction and in plaster showed the special exercises they perform for five minutes every hour of the day. Sandbags of graduated weight, made by the patients themselves were at the foot of nearly every bed. Simple gymnastic apparatus, billiard tables, dart boards, and tenniquoits were in the solaria. The orderlies, taught the patients exercises, and supervised occupational therapy, Morse communication across the ward, and simple games in the grounds. A film showing all stagges of treatment from early ward exercises, to treatment in special rehabilitation centres, and finally in flying units was shown by Flight Lieutenant A. Zinovieff.

# Dislocation of the Knee-joint with Capsular Interposition

By Group Captain H. OSMOND CLARKE

Complete dislocations of the knee are rare; they are usually easy to reduce, and if reduction is efficiently maintained a stable, mobile and, sometimes, normal joint can be Certain complications may occur; for example, external popliteal nerve lesions produced by over-stretching in forcible adduction injuries, or by inclusion of the nerve in the joint; more rarely gangrene has followed rupture or occlusion of the popliteal artery. The following case is an example of difficulty in reduction and the cause for that difficulty

On May 25, 1941, a Czech air-observer aged 26, a slender youth of magnificent spirit, sustained a dislocation of the knee in which the tibia was displaced postero-laterally on the femur. All manipulative efforts failed to effect complete reduction. The backward displacement was easily overcome but the lateral shift persisted stubbornly. ing to force reduction, the skin furrowed over the medial joint line as if it were being drawn into the joint. Unfortunately the initial violence had forced the medial femoral condyle so hard against the overlying skin that an area was devascularized and subsequently formed an ulcer. While awaiting healing of the ulcer, correction of the backward displacement was maintained in a plaster of Paris splint. This undoubtedly made the subsequent operation easier and is well worth while if, for one reason or another, a necessary open correction must be postponed. At operation the morbid anatomy of the injury was easily demonstrated. The capsule and quadriceps expansion was torn from the vastus internus, the internal ligament was avulsed from its femoral attachment, and the capsular flap lay interposed between femoral condyle and tibial tuberosity.

The condition may be compared with forcing a large button (the medial femoral condyle) through an irregular buttonhole (the tear in the capsule) which becomes so entangled around the button that manipulative extrication is impossible. cartilage was removed, the capsule and internal lateral ligament dissected off the cruciate ligaments and the fat pad, and reinserted to the femoral condyle. A completely congru-ous reduction was achieved and held in plaster for twelve weeks. To-day this officer, following intensive rehabilitation and two manipulations, walks without a trace of limp, has a stable joint with 80 degrees of flexion from the straight position under powerful muscular control. He has been on ground duties for the past four months. It was a great pleasure to him, and most gratifying to me, when a few days ago I recommended his return to flying duties.

# A Method of Bone Grafting the Tibia and Fibula

By Wing Commander J. R. Armstrong

In bone grafting a fracture of the tibia and fibula the surgeon has three objects: (1) To reduce the fracture, placing the fractured surfaces in intimate contact and restoring normal alignment; (2) to secure the reduction by internal fixation which is mechanically stable; (3) to establish favourable conditions for bony union. Bone union is facilitated when the operation restores normal architectural structure, when bone absorption and new bone formation is minimal, and when close and stable contact is secured between large areas of raw bone on the graft and host, so that revascularization is rapid and easy.

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The usual inlay or onlay bone grafting technique does not always give sufficiently stable fixation, and it is not easy to secure accurate alignment of the fragments. I have, therefore, used a modification of the so-called "split-bone" technique described by Gill in fractures of the radius and ulna.

The tibia is exposed subperiosteally along its whole length. The fracture is reduced and held in position by clamps of the Lowman type applied to the posterior surface of the bone, so that the anterior two-thirds are left free. Care is taken to secure correct alignment of the fragments and it is often necessary to refracture or divide the fibula. Using a large diameter single saw the bone is split along half its length, in such a way that two-thirds of the divided area lie on the longer fragment, and one-third on the shorter fragment. The large graft thus produced is laid across the fracture and fixed with four vitallium screws; the gap is filled with the shorter fragment. Radiograms are taken to confirm the accuracy of alignment of the fragments. The normal bowing of the tibia varies so much from individual to individual that it is not always easy to ensure correct alignment without radiograms. If slight medial or lateral bowing is shown, this is easily corrected by removing the lowest screw, angling the lower fragment as much as may be necessary, and reinserting the screw. When the alignment is satisfactory the periosteum and skin are closed, and the fracture is treated in plaster in the usual way.

This operation is mechanically sound; the technique is simple; alignment can be controlled perfectly; the operation involves only the injured limb, no graft being taken from the normal limb; it is followed by rapid and certain union.

# Impacted Fracture-dislocation of the Tarsal Navicular

## By Wing Commander I. L. DICK

On 6.11.41 P. E. C. was pulled up by a balloon cable in the dark and fell about 10 feet sustaining a fracture-dislocation of the talo-navicular joint. The fracture extended transversely across the lower third of the navicular and the large upper fragment was displaced dorsally on to the upper surface of the head of the talus. Two attempts at manipulative reduction failed. A third attempt at manipulative reduction aided by strong skeletal traction by means of a pin through the os calcis and a Kirschner wire through the bases of the metatarsals also failed.

While skeletal traction was maintained the displaced bone was exposed through a short dorsal incision. As the soft tissue was cleared from its proximal surface the navicular sprang back into position. The reason for the failure of manipulative reduction had been the impingement and wedging of the sharp edge of the navicular into a small depressed fracture on the upper surface of the head of the talus. Reduction by open operation was effected with ease and with minimal disturbance of the soft parts. Radiograms showed that reduction was anatomically accurate and that the major portions of the articular surfaces of the navicular were undamaged. It was therefore hoped that avascular necrosis of the navicular and osteo-arthritis of the involved joints might not occur and primary fusion of these joints was not done. The foot was immobilized in plaster for ten weeks. Four weeks later he returned to duty able to walk 4 miles in complete comfort without swelling of the foot. Mid-tarsal movement was somewhat limited but it was painless throughout its range.

Two months later he reported pain in the foot as he walked and examination showed that mid-tarsal movement was more limited and painful. X-rays showed that, though the texture of the navicular was normal and there was no sign of avascularity, osteoarthritis was already established in the talo-navicular and naviculo-cuneiform joints. These joints were accordingly fused on 10.6.42.

This case confirms the view that if open reduction is required for a fracture dislocation of the tarsal navicular, primary fusion of the involved joints is indicated. Even in closed fractures of the tarsal scaphoid in which manipulative reduction succeeds, consideration should be given to the desirability of primary fusion of the involved joints when there is distortion of the joint surfaces.

# Bone Pegging the Carpal Scaphoid

# By Wing Commander A. A. BUTLER

Fracture of the carpal scaphoid is a frequent Service injury, and in a large series of fractures seen in the Weeton Clinic bone grafting was considered advisable in 50 patients. Originally the technique of Burnett (1937) and later the technique of Armstrong (1941) was employed, but some difficulty was experienced in accurately placing a large drill in this small bone which lies in an oblique position. Armstrong (1941) has pointed out that the long axis of the scaphoid lies at an angle of 45 degrees to the transverse plane of the wrist, and 40 degrees to the long axis of the limb. A special arm rest was

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therefore devised which holds the limb in this position, so that the long axis of the scaphoid is exactly vertical. In this way it is unnecessary to estimate difficult angles; the surgeon need only concentrate on keeping the drill strictly vertical. The rest holds the arm more securely than is possible by an assistant, and since the position is never changed, all radiograms are comparable and easily interpreted. The rest, which is made of aluminium and can be sterilized, is fitted with a shelf to hold an X-ray plate in the correct position so that radiograms can be taken at various stages throughout the operation.

Brachial plexus block anæsthesia is used. The incision is placed over the tubercle of the scaphoid. A  $\frac{1}{16}$  in. motor drill is inserted vertically to a depth of 34 in. entering the lateral side of the scaphoid tubercle which is the centre of the vertically held bone. Radiograms usually show that the drill is correctly placed on its first insertion; if this is not so, the necessary correction is easily made. When the position is perfect the drill hole is enlarged to  $\frac{7}{32}$  in. diameter by means of a cannulated trephine passed over the drill guide. A graft of the same thickness is taken with a dowel cutter from the olecranon. The tip of the graft is bevelled, and driven into the scaphoid drill hole. The position is checked by X-ray, the fracture impacted, the wound closed and a full-arm padded plaster applied. On the twenty-first day a forearm skin-tight plaster is applied, firmly moulded round the wrist-joint and palm, and extending almost to the interphalangeal joint of the thumb. The patient then resumes light duty and returns monthly for supervision.

Using this technique the bone graft has been well placed every time. The danger of damage to the articular surface due to a wrongly placed drill has been avoided, even in fractures near the proximal pole which present the greatest difficulty. The operation is usually completed within thirty minutes. It has been used in cases of established non-union, of delayed union, and in recent fractures in which delayed union is very probable such as fractures with mid-carpal dislocation or with wide displacement of the fragments. It is true that fractures with delayed union unite even without bone grafting if plaster immobilization is continued long enough, but in these cases it is believed that grafting is justified because of the considerable saving of time. In fourteen cases union was obtained in an average time of three months. In fractures with established non-union, grafting is considered advisable in order to prevent the onset of arthritis. In eighteen cases, union occurred in an average of five months. Of the remaining cases in the series eight are still in plaster, and ten having returned to duty have been posted elsewhere so that late follow-up has not been possible.

DEFEDENCES

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## Fracture Internal Malleolus and Diastasis Inferior Tibio-fibular Joint

By Wing Commander D. M. MEEKISON

For some years the writer has employed the method of open reduction and internal fixation of isolated fractures of the internal malleolus using a metal screw; since the introduction of vitallium this has been the metal of choice. Screw fixation has also been used for cases of diastasis of the distal tibio-fibular joint. The types of injury may be analysed thus:

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Diastasis distal tibio-fibular joint				***		 0.00	***	11 '		

(simple 7, with fracture fibula 4)

Of the 34 patients, 22 were air crew, whose early return to duty is of great importance. The average age of 22½ years (excluding 1 patient of 57) was very favourable, only two other patients being over 30.

The operative procedure used is dictated by the type of injury. In all cases the preoperative preparation is the same, i.e. thorough cleansing with soap and water, spirit and acriflavine twice or three times daily for a minimum of two days, preferably three. The limb is kept wrapped in sterile towels. In all cases a direct approach is made, because in the author's experience a scar over a bony prominence never causes discomfort or inconvenience. All operations are done under general anæsthesia and with a tourniquet.

Fracture internal malleolus.—Sufficient exposure is made to visualize both anterior and posterior margins of the tibia. All fractures in this series showed interposition of tissue between the malleolus and shaft; occasionally a small loose fragment is found in the joint. The fracture line is thoroughly cleaned out and the fragment replaced in accurate position. The two criteria of accurate reduction are fitting of the "pattern" of the fracture line, and congruity of the anterior and posterior margins of the tibia. While

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the malleolus is held in position by the assistant with a sharp hook, a vitallium screw is passed obliquely upwards through the fragment into the shaft, after a suitable drill hole has been made. The head of the screw is buried under the internal collateral ligament. The wound is closed and a padded cast applied. This is changed after ten to fourteen days to a new non-padded cast with a walking heel of sorbo rubber, in which weight bearing is permitted. Walking irons are not used in the plaster; they are to be condemned. Fixation is discontinued in six or seven weeks, and this is followed by viscopaste for a week or more. Rehabilitation may or may not be necessary.

Fibular fractures with diastasis.-A direct approach is made and when the fracture is accurately reduced it is held with a 4 hole vitallium plate, 3 short screws holding the fibula and one long screw in the second from top hole, transfixing the fibula to the tibia. The plate and screws may have to be removed later owing to their prominence.

Simple diastasis.-It should be noted that diastasis of the distal tibio-fibular joint may easily be missed. All injured ankles should be X-rayed in inversion and eversion when the original radiogram reveals no fracture. Unless the diastasis is diagnosed the patient may be left with a "sloppy" ankle. If radiograms show widening of the tibio-fibular joint and lateral movement of the astragalus, a short incision is made 1 in. above the ankle-joint and the fibula fixed to the tibia with a simple, long vitallium screw while the distal tibio-fibular joint is held snugly in position.

There was only one complication-sepsis in one case. This was the 57 years old patient with a severe fracture of the ankle, who was operated upon in the presence of an abrasion, not thoroughly healed, adjacent to the line of incision. At his cost, the lesson of the danger of abrasions has been driven home. Of the 34 cases, 14 have normal ankles, 17 are still under treatment without complications, 2 have good results (arthritic changes in 1, and flat foot in 1) and one has a bad result (sepsis). One sergeant with a simple diastasis made a trip to the Ruhr thirty-seven days after operation, and has what seems to be a normal symptom-free ankle.

# Co-operation Between Plastic and Orthopædic Surgery

## By Wing Commander George H. Morley, R.A.F.

FIVE cases are presented to indicate the field of co-operation between plastic and orthopædic surgery.

Five cases are presented to indicate the field of co-operation between plastic and orthopædic surgery.

CASE I.—Free split-skin graft, first day after accident. A pilot sustained a comminuted fracture of both bones of the forearm with serious fragmentation of the bones and dislocation of both superior and inferior radioulars joints. There was "deglowing" of skin from the elbow, all except a narrow strip 4 in. by 1 in, being torn downwards from 2 in, above the elbow to 2 in, below the joint.

The day after injury, the skin flaps were united across the anterior aspect of the joint, and the remaining denuded area covered with a Thierseh graft from the thigh. The "take" was nearly 100% but the upper 2 in. of the skin flap, being stripped from its blood supply, underwent necrosis. One month later pinch grafts were applied to this area. The skin was completely healed two months after injury, thus making it possible to perform a bone graft to the ulna at the third month, a bone graft to the radius at the fourth month and an excision of the head of the radius with inferior radio-ulnar arthroplasty at seven months. He is now on limited flying duties ten months after injury, with full movement of the elbow and wrist.

CASE II.—Delayed primary split-skin graft, to heal lurge granulating wound. Sergeant Pilot E. received a bullet wound of the right hand, most of the index finger being shot away, and the index metacarpal subsequently removed. He was first seen three weeks after injury, with a large granulating wound and stiffness of ingers and thumb. At the first change of plaster a split-skin graft was applied as a dressing. There was almost 100% "take", and within ten days it was possible to begin rehabilitation of the hand and regain mobility of the finger-joints. The transplanted skin lay directly upon the irregular carpal bones, and the cosmetic result was poor. A direct delayed flap of abdominal skin was therefore applied after removing all scar rissue, thus improving both function and appearance. Nine months after in

was applied. The result is a hand with 100% or inovenient in an appearance of the right femur, facial lacerations, burns of the face, left thigh, leg and both ankles. In consequence of the bone injury, saline that treatment was impracticable and the burns were coagulated with triple dye. Later, the burn of the left thigh and leg required skin grafting, and pinch trafts were applied, with successful healing within three weeks. Full movement of the knee was regained. This is an example of the use of pinch grafts in a case where three factors indicate their use: (a) The cosmetic appearance was unimportant: (b) the donor area was limited as compared with the defect to be epithelialized; (e) the granulations were slightly infected.

The wide field of plastic-orthopædic co-operation may be summarized:

(1) Early healing of wounds, especially wounds with skin loss.—Early epithelialization limits the scar tissue laid down in the process of healing and lessens soft tissue contracew is

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ture. Free skin grafts should therefore be applied either at the time of the primary operation or at the first change of plaster. These grafts should be regarded as dressings, and they frequently heal such wounds within a few days. They will take on any normal tissue except bare bone or cartilage, particularly well on muscle. Sulphonamide powder may with advantage be applied beneath such grafts.

(2) The late healing of wounds.—It is usually advisable to excise all scar until normal tissues are exposed. It is futile to apply a skin graft to an indolent area of granulations which is unable to support the natural growth of epithelium from the periphery because of its dense fibrous tissue base.

(3) The provision of a safe area of skin through which a bone can be approached surgically.—A flap of skin and subcutaneous tissue may be transferred directly from a conveniently situated area or transported from a more distant area in the form of a tubed pedicle graft. It is sometimes found that healing of the wound and relief from recurrent ulceration have removed the factors which were inhibiting union of the fracture. Bone grafting may thereby be avoided.

(4) Providing an amputation stump with sturdy skin.—Cross-leg flaps may be used to replace unstable scars on stumps where there is a shortage of skin, provided that there is no necrosis of bone. These flaps are particularly indicated when reamputation is inadvisable, e.g. because the stump is already short. In the case of the arm, direct flaps from the chest wall may be used.

(5) Relief of soft tissue contracture.—After excision of all scar tissue the resulting skin defect may be covered with a flap or with free grafts. Flaps are indicated where there is probability of recurrent contracture.

## Fixation of Oblique and Spiral Fractures of the Tibia by a Single Vitallium Screw

By Wing Commander A. RONALD

A short series of fractures of the tibia and fibula is presented to demonstrate the advantages of operative reduction and fixation by means of a single vitallium screw. The operation is performed seven to ten days after injury through a 4 in. incision. The fracture is reduced and the bone ends held in a Hey Grove's clamp. A vitallium screw of the correct length is then placed as nearly as possible at right angles to the line of fracture, so that it transfixes an equal thickness of bone in each fragment, and engages the cortex of each fragment. Correct placing of the screw is relatively easy in oblique and spiral fractures but more difficult when the fracture is transverse. In order to avoid subcutaneous projection of the head of the screw, a V-notch is cut ½ in. deep. The hole is drilled from the apex of the notch, which is then deepened sufficiently to accommodate the head of the screw. The screw is driven home, the stability of reduction tested, periosteum closed, skin sutured and a padded plaster applied. Two weeks later, an unpadded plaster is applied. In spiral fractures, plaster fixation can usually be discarded in seven to nine weeks, and weight bearing in plaster may be safe even earlier than this. Transverse and comminuted fractures are immobilized in plaster for an average period of eleven to twelve weeks.

Treatment by this technique has been completed in 12 fractures of which 9 were spiral, 1 transverse and 2 comminuted. In every case union is sound by clinical and X-ray tests. The average time of union was several weeks less than the general average in tibial fractures treated by all methods, and many weeks less than in fractures treated by heavy skeletal traction. The instability of oblique and spiral fractures makes it necessary to prevent redisplacement either by internal fixation or by continuous traction. The advantage of this method of internal fixation is that perfect apposition and excellent fixation is secured with a minimum of foreign material, and rapid union is promoted. Unlike methods of continuous traction, the patient is ambulatory at an early date, his stay in hospital is minimized, and the period of immobilization in plaster is reduced. There is, therefore, minimal stiffness of knee and ankle joints and in all cases movement of these joints returned rapidly. The only disadvantage of the technique is the risk of sepsis; this is under the control of the surgeon and in normal conditions should not arise.

# Traumatic Asphyxia and Disruption of the Pelvis

By Squadron Leader H. M. COLEMAN

A 20-year-old flight mechanic was returning to the dispersal point in a 30 cwt. lorry, when it overturned on a corner. He was pinned under the frame-work of the lorry, but was released in about two minutes. The weight was taken across his upper abdomen and lower chest, where he had minor bruising. He remembers a feeling of pressure across the abdomen spreading upwards as if the blood was being forced to the top of his body and head. He then lost consciousness, and next remembers being put on a stretcher with his legs tied together. His

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vision was blurred as though looking through a mist. This gradually cleared, and within about three hours he

vision was blurred as though looking through a mist. This gradually cleared, and within about three hours he was able to see normally.

His friend states that by the time he was in the ambulance, approximately ten minutes after the accident, he was conscious, breathing heavily and slowly, his chest red and his face turning purple. On admission to Station Sick Quarters a few minutes later he was fully conscious, face and chest a deep purple, bleeding from both cars and nostrils, subconjunctival hæmerrhage in both eyes, pupils equal and reacted to light, pulse 84, respirations not increased. A few hours later he was seen-by Air Commodore Stanford Cade, who reported that the face, forehead, chest and upper arms were violet in colour with cedema of the cyclic and conjunctiva and hæmorrhage on both drums. B.P. 100,60. Patient shocked. Blood-stained urine was passed and a fractured pelvis and possible fracture of the base of the skull were diagnosed.

The next day, when transferred to P.M., R.A.F. Hospital, he presented a startling picture. The conjunctive were blood red, cedematous, and gave the appearance of exophthalmos. The forehead, face, neck, chest and upper arms showed a deep violet red pigmentation. The absence of blanching under the pressure of a glass spatula showed that the blood was extravasated, and differentiated the condition from simple hyperamia or congestion. The mark of his braces and collar were clearly outlined, by the absence of ecchymotic spots due to their supporting pressure. Even the outline of his collar stud could be seen.

The patient bad also sustained fracture through both right pubic rami, a dislocation of the symphysis pubis, and a fracture through the secral ala with upward dislocation of the left half of the pelvis. This was reduced and progress is satisfactory. There were also fractures of the transverse processes of the 5rd, 4th, and 5th lumbar vertebrae. Two ribs were fractured. Pulmonary adema and congestion developed with rises in both lungs, rise in temperature, rapid pulse a

This is a classical example of the rare condition of traumatic asphyxia first described in 1837 by Ollivier, with typical "masque ecchymotique". The distribution of ecchymosis and the absence of pigmentation where light external pressure was maintained by braces, collar and collar stud, support the view that blood was forced backwards by pressure on the chest into the innominate, internal and external jugular veins which are unprotected by functioning valves, and therefore into the skin of the head and neck. The skin pigmentation gradually faded but did not go through the colour changes one might expect after blood extravasation. Within three weeks the skin appeared normal. There was, however, still some staining of conjunctivæ two months after injury. Vision was normal  $\frac{6}{6}$ , there was no optic atrophy and no impairment of hearing.

### Early Excision of Avascular Fragment of Fractured Carpal Navicular Bone

By Squadron Leader N. VERE-HODGE

THE accepted modern treatment of fractures of the waist of the carpal navicular bone with avascularity of the proximal fragment is prolonged immobilization in plaster with or without a bone grafting operation. The results are sometimes disappointing because loss of blood supply of the bone and degenerative chondritis lead to the rapid development of arthritis of the wrist-joint. No advantage is to be gained by late excision after arthritis has developed, but it has been suggested that early excision of the proximal fragment performed as soon as avascularity is recognized, may prevent the complication.

A flight mechanic, aged 21, injured his wrist in April 1941. He had continual pain, there was only a shiver of active movement, and the grip was weak. Two months later, when he reported sick, radiological examination showed a fracture of the waist of the carpal navicular. Plaster was applied, but after six weeks, radiograms showed that the proximal fragment was markedly avascular. Operation was performed without delay and the proximal fragment was excised. Post-operative treatment consisted of three weeks' immobilization in plaster followed by gradual mobilization and strengthening exercises.

He returned to his trade as a flight mechanic three months after operation. The wrist was comfortable; the grip was good; he had 50 degrees active dorsification and 30 degrees palmar flexion. Six months later he states that he can lift weights up to 100 lb., and that even after a heavy day's work he has no symptoms. The wrist is not quite as good as before the accident, but it is infinitely better than before operation. There is now 56 degrees active dorsification (60 degrees on the normal side). Radiograms show no evidence of arthritis; the fractured surface of the remaining fragment of the navicular is rounded and smooth.

No general conclusion is to be drawn from a single case, but in view of the prolonged immobilization which would have been needed to secure union of this fracture, the probable necessity for a bone grafting operation, and the great probability of arthritis, the rapid return of good function in this patient after early excision of the avascular and necrotic fragment, is worthy of record.

#### Fractures of the Head of the Radius

By Flight Lieutenant A. E. Burton

THE results of investigation in a consecutive series of 50 fractures of the head of the radius have been analysed. The age-incidence ranged from 18 to 41 years (a typical R.A.F. service age-group), and 70% were air crew members or skilled technicians. Three groups of fractures were identified, each with a distinctive mechanism of injury. Type 1: The impaled fracture from a fall on the outstretched pronated hand. The head of the radius was impaled on the capitellum which was injured at the same time that the head of the radius is fractured. The damage to the capitellum was seldom shown radiographically because only articular cartilage was involved, but the injury may be disclosed by a second X-ray fourteen days later. Type 2: The marginal fracture. This occurred as the ours he

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result of an abduction strain on the elbow with the forearm pronated; a segment of the articular surface was displaced. Injury to the capitellum sometimes occurred. Type 3: Undisplaced fissure fracture. This occurred from a direct injury to the elbow causing a transverse fissure fracture without displacement. In nearly all cases of impaled fracture, excision of the head of the radius was advisable, particularly in view of the frequency with which articular cartilage damage was disclosed at operation although not seen in X-rays. In marginal fractures excision was performed when there was displacement of the segment, or disturbance in the integrity of the articular plateau. Marginal fractures without displacement and fissure fractures were treated conservatively

After three days' pre-operative skin preparation, the bone was excised through a short 2 in incision directly over the head of the radius, deepened through the capsule with minimal dissection. Care was taken to avoid damage to the attachments of the orbicular ligament round the neck. The margin of the bone was smoothed off and a flap of periosteum placed over it. Active movements were begun twenty-four hours after operation

but no massage or passive movement was used at any stage.

In no case in this series of 50 fractures was there instability of the superior or inferior radio-ulnar joints, cubitus valgus or new bone formation at the site of excision. The results are summarized below, the following criteria being used: Excellent—powerful arm, symptom free, full range of movement. Good—powerful arm, symptom free, less than 15 degrees limitation of extension movement. Fair—powerful arm, symptom free, more than 20 degrees limitation of extension movement. Unsatisfactory-residual symptoms and restricted movement.

(1) Impaled fracture of radial head-29 cases. (a) Excision-20 cases. 17 good or excellent-average disability period 6 weeks. 3 fair or unsatisfactory.

(b) No operation—9 cases. 2 good—average disability period 31 weeks. 7 fair or unsatisfactory.

(2) Marginal fracture of radial head with displacement-5 cases. Excision—5 cases. 5 good or excellent—disability period 6 weeks.

(3) Marginal and fissure fractures without displacement-16 cases. No operation-16 cases. 12 good or excellent-disability period 6.5 weeks. 4 fair or unsatisfactory.

# Sprains and Subluxations of the Ankle-joint

By Flying Officer J. ROWLAND HUGHES

So-called sprains of the ankle-joint are frequently complicated by tilting of the astragalus in the tibio-fibular mortice. Fifty-seven consecutive cases of ankle injury showing no bony damage have been studied with routine radiograms of both ankles in full inversion. Twenty-eight cases were simple sprains, with no tilting of the astragalus (49%). Twenty-nine cases showed degrees of tilting varying from 3 to 35 degrees (50%). Three cases showed diastasis of the inferior tibio-fibular joint. Those showing tilting of the astragalus were divided into three groups: Group I, 5 degrees tilt and less: 10 cases. Group II, 5-10 degrees tilt: 8 cases. Group III, over 10 degrees tilt: 8 cases.

The physical signs were variable, and the degree of local trauma was not necessarily related to the degree of tilting, but the tenderness in simple sprains and minor tilts was more often over the anterior expansion of the external lateral ligament, whereas with major tilting tenderness was below and behind the external malleolus, i.e. over the middle fasciculus. It must be stressed that in recent subluxations there is often considerable swelling and the sulcus below the external malleolus on inverting the foot,

which characterizes recurrent subluxation, may be obscured.

The pathology in severe Group III types of injury is probably a complete rupture of the middle fasciculus of the external lateral ligament which is much the strongest of the three components (fig. 1 (a)). It is suggested that this occurs when the foot is forcibly inverted with the ankle at right angles. In this position the fibres of the middle fasciculus are almost vertical, whereas those of the anterior fasciculus and posterior fasciculus are horizontal. Forcible inversion with the foot in plantar flexion is more likely to tear the anterior fasciculus whose fibres are tending to become more vertical whilst those of the middle fasciculus are becoming more horizontal (fig. 1). It is probable that this is the type of lesion which occurs in most simple sprains and does not give rise to appreciable degrees of tilting. Rupture of the middle fasciculus is depicted diagrammatically in

fig. 1 (b), which also illustrates how the lesion is only revealed on inversion of the ankle.

The importance of recognizing recent tears of the middle fasciculus is illustrated by the frequency with which recurrent subluxation occurs. This was present in almost 25% of the above cases and often required operative reconstruction of the ligament. The diagnosis is fraught with many pitfalls: (1) While the ankle is being radiographed, the

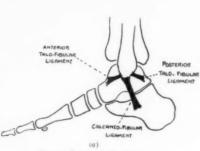
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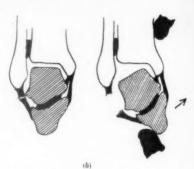
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Lateral ligaments of ankle.



Rupture of calcaneo-fibular ligament. Antero-posterior. On inversion



FIG.



FIG. 3

FIGS. 2 and 3.—Subluxation of astragalus due to recent rupture of lateral ligament, with 19° tilt on inversion (fig. 3). Normal appearance of ankle in the antero-posterior view (fig. 2).

foot must be held in full inversion by a competent person holding the os calcis and the forefoot; it is not sufficient to hold the forefoot alone when X-raying (figs. 2 and 3). (2) If a definite tilt of the astragalus is noted (fig. 3), inquiry must be made into the history of previous trauma or symptoms—it may be a case of recurrent subluxation which will not benefit by eight weeks' immobilization in plaster. (3) The other ankle should always be X-rayed in full inversion for comparison. 25% of cases in the above series showed some degree of tilting in the contralateral ankle. (4) The injection locally of 10 c.c. of 2% novocain will often reveal a hitherto undisclosed tilt; pain having been relieved, peroneal spasm disappears. This emphasizes the necessity for X-raying in full inversion all ankles treated by local anæsthetic injection before walking is allowed.

Minor degrees of tilting of the astragalus demand no rigid immobilization; tilts of 3, 4 and 5 degrees are quite often seen in the contralateral ankle without symptoms or history of injury. Novocain injection or viscopaste for ten to fourteen days, or in cases with severe swelling, a walking cast for the same period, is sufficient. Group III and the severer Group II cases require rigid immobilization in a walking plaster for not less than eight to ten weeks. In cases of recurrent subluxation, operation for the reconstruction of the external lateral ligament of the ankle must have, as its primary object, the reconstruction of the middle fasciculus.

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# Section of Proctology

President-A. LAWRENCE ABEL, M.S.

[June 10, 1942]

#### DISCUSSION ON THE TREATMENT OF INOPERABLE CARCINOMA OF THE RECTUM

Mr. W. B. Gabriel: In defining what we mean by "inoperable" carcinoma of the rectum, several different groups of cases would appear to be involved: in some the fact of inoperability is obvious either clinically or on abdominal exploration, and in others the estimate of inoperability is a much more individual and personal matter in which the surgeon is chiefly concerned. The surgeon in charge of a borderline case will naturally be influenced by his experience and surgical facilities, and if a radical operation is contemplated his decision may in some cases be considerably affected by pathological and medical findings. Four groups of cases can be distinguished.

(1) Locally operable and suitable for radical operation which, however, cannot be proceeded with by reason of some general condition such as senility, mental instability, accompanying disease such as active pulmonary tuberculosis, severe degrees of renal or cardiac failure, or severe diabetes with complications. Refusal by the patient to have a colostomy or even a cutting operation of any sort is sometimes the reason for relegating an early carcinoma to the inoperable group. In these cases with a small malignant growth the natural expectation of life is fairly lengthy, and it is in these cases particularly that the choice of the best line of treatment is so important,

(2) Locally operable but with metastases in the liver.—Early venous spread to the liver is usually only discovered on abdominal exploration and, since the growth is probably non-obstructive and the expectation of life short, expectant treatment without colostomy

The question of a "palliative" radical operation comes under this heading. Patients should not be subjected to the dangers and pain of a radical operation when there is no hope of cure by surgery. If there is any doubt as to the nature of a small nodule in the liver one must endeavour to inspect it by extending the paramedian incision upwards to see if the nodule is a white secondary deposit or a bluish-coloured cyst. If, however, it proves impossible to view it, then a radical excision should be made. On several occasions I have felt a large gall-stone in a shrunken gall-bladder which required some care to distinguish it from a secondary deposit.

(3) Locally borderline or inoperable without clinical evidence of metastases.-It is obviously more easy to form a clinical estimate of a low carcinoma than a high one. In the female a low, deeply ulcerated carcinoma extending into or through the posterior vaginal wall may with reason be assessed as inoperable but yet be properly treated by a diathermy perineal excision, and the same type of operation is often the best thing for a late carcinoma involving the anal canal or fungating outside the anus. In the male, a deep malignant ulcer which has extended through the rectal wall anteriorly and can be felt to be firmly attached to the prostate or urethra is hopeless and requires a palliative colostomy. In the middle third of the rectum fixity posteriorly may only indicate that the growth has extended through by direct continuity to the ensheathing pelvic fascia, and may still be removable by a combined excision. Palpable extrarectal induration laterally and anteriorly is of more serious import, and if nodules of growth can be felt high up in the posterior fornix the growth is certainly inoperable. With regard to the upper third of the rectum we who have experience in rectal carcinoma must refuse to label advanced or borderline cases as inoperable until they have been proved to be so by We must not be deterred by clinical "bad risk" features such as: laparotomy.

<sup>(1)</sup> Advanced age—no arbitrary upper age limit should be recognized for radical operation, and I can record a successful perineo-abdominal excision in a man of 84.

(2) High or low blood-pressure—this calls for close co-operation with the anæsthetist and care in the dosage of spinal snaresthesis.

(3) Mild degrees of urinary failure
(4) Secondary anæmia
(5) Some degree of intestinal obstruction
(6) Smooth enlargement of the liver—this is not necessarily due to metastases.

(7) Apparent fixity of the growth.

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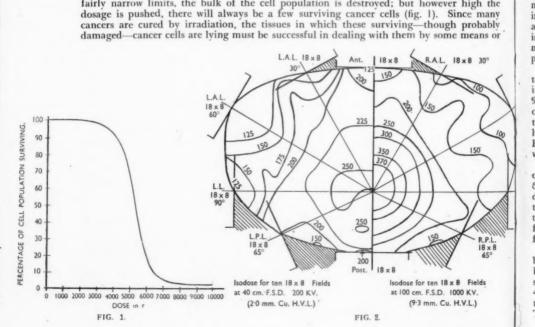
The last finding is one which is often most misleading, especially in short stout subjects with a fairly large growth, a short fat-laden pelvic mesocolon, and a narrow pelvis, and my experience has been that it is more common to find a borderline case operable than it is unexpectedly to find secondary deposits in the liver or some other evidence of inoperable upward spread.

If we make a practice of exploring these poor-risk and borderline cases the operations both for general ward and private patients should be done in hospitals, where there are the best facilities for co-operation and team-work both on the part of our colleagues and skilled surgical assistants, as well as the operating theatre staff and the nursing staff. When setting out to explore a borderline case the patient should be prepared and anæsthetized and all preparations made as for a radical operation, and the surgeon should have no pressing appointment afterwards which might vitiate his judgment or give him the feeling of being crowded for time. When starting a "laparotomy and proceed" for a recto-sigmoid carcinoma of doubtful operability I like to feel that time is of no importance, whether the operation takes anything from one to two and a half hours.

(4) Locally borderline or inoperable with evidence of abdominal metastases.—In this group the evidence of abdominal spread may be on clinical grounds such as palpable deposits in the liver, palpable secondary intraperitoneal masses, ascites or jaundice. Laparotomy provides more exact information as to local fixity, invasion of other viscera, and evidence of peritoneal and lymphatic spread. In most cases in this group (except in the final stages of the disease indicated above) exploratory laparotomy enables the surgeon to ascertain if obstruction is present or impending, and whether a colostomy is indicated. If peritoneal plaques or secondary deposits in the omentum are found a biopsy can be made, and a sound opinion as to prognosis can be formulated.

Mr. Ralph Phillips: One often hears it said that carcinoma of the rectum is not addiosensitive. Radiosensitivity, however, is not synonymous with curability. Rather is the contrary the case, for in general the most radiosensitive growths are those which exhibit extreme anaplasia of structure; and correlated with this anaplasia is a tendency to widespread dissemination, which makes cure highly improbable. By contrast, tumours showing a high degree of differentiation of structure, such as an epithelioma of the anus, are usually quite readily curable by radiation methods.

Radiation can never destroy every cancer cell in a malignant growth, for the lethal effect of radiation on any biological population is represented by a sigmoid survival curve—below a certain threshold of dosage, no cancer cells are killed; between certain fairly narrow limits, the bulk of the cell population is destroyed; but however high the dosage is pushed, there will always be a few surviving cancer cells (fig. 1). Since many cancers are cured by irradiation, the tissues in which these surviving-though probably damaged—cancer cells are lying must be successful in dealing with them by some means or



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I.P.L. 8 x 8 65° other. Thus in radiotherapy, the radiosensitivity of the tumour bed—as these normal tissues may be called—is just as important as that of the cancer cells; for if the tumour bed is also badly damaged by irradiation, the surviving cancer cells have time to recover before they can be dealt with, and the tumour resumes its growth. In their turn, the health of the normal tissues which constitute the tumour bed depends upon the general condition of the body as a whole. Thus, of the three factors concerned in the curability of carcinoma of the rectum, the radiosensitivity of the malignant cells is the least important; next comes the state of the tumour bed, whether relatively healthy or already damaged by sepsis or surgical interference; and most important of the three, the general vitality of the patient.

The first essential in the radiotherapy of inoperable carcinoma of the rectum therefore is to select those cases in which there is a prospect of cure. The advanced cancer cannot be cured and radiation is given only for certain limited objectives—hæmorrhage can be stopped, discharge can be lessened, and pain, in so far as it is rectal in origin, can be relieved. Pain due to the involvement of the spinal nerves is better treated by other

methods.

This incurability of advanced cancer has been for me best illustrated by recurrent cases; I think surgeons recognize that an advanced case is often best left alone, but for one recurring after operation they always hope that the situation may yet be retrieved. But in most cases recurrence after operation is widespread, and there is often sepsis and a perineal sinus as well. Of the 22 recurrent cases which have been treated by the million-volt X-ray apparatus, 18 have been of this widespread nature, and for them radiotherapy has really nothing to offer, although occasionally worthwhile improvement has been obtained.

TABLE I.-CARCINOMA OF RECTUM, 65 CASES.

A. Recurrent after Radical Operation—22.

Apparently cured—1.

Marked improvement—5.

B. Inoperable primary growth with liver metastases also—4.

Arrest of primary growth—2.

C. Inoperable primary growth without clinical metastases—32.

harked improvement—14.

Marked improvement—14.

Growth-free for more than three years—3.

D. Operable primary growth, but operation inadvisable—7.

Growth-free following radiation—6. (None of these 7 cases has a colostomy)

In 32 cases the local extent of the growth made them inoperable, and they were all radically irradiated, that is, cure was aimed at. Cure was attempted because there was no clinical evidence of metastases outside the pelvis, but not a few of these cases I should now recognize as nevertheless too advanced for curative therapy; thus 12 of them died in less than one year after treatment. Leaving aside the question of palliation—always a rather subjective assessment—disappearance of the inoperable carcinoma was obtained in 11 of these 32 cases following X-rays alone, and in a further 3 cases after additional measures: intrarectal radium in 1 case, surgical diathermy in the second, and subsequent perineal excision in the third.

Whether the disappearance is permanent—that is, whether cure will be obtained—it is too early to estimate. 5 of the 14 cases are already dead, but in none was there recurrence in the rectum, and only 1 of the 5 died from metastases. The longest-standing of the 9 still living has now passed her fourth anniversary since treatment, and has had her colostomy closed for the past eighteen months; there are 2 more who have passed their third anniversary, and in one of these there were metastases in the lymph glands as high as the origin of the inferior mesenteric artery when the colostomy was made. Even if these 3 are the only permanent cures out of the 32—and I think their number will certainly be added to—that is still a salvage of 1:10 of otherwise doomed cases.

Finally there are 7 cases in which the rectal growth was operable, but the general condition of the patient precluded surgery. None of these 7 had a colostomy, and in 6 of them the carcinoma disappeared after X-ray treatment. One of these 6 had coronary disease, from which he died twenty-one months after treatment of the carcinoma of the rectum; it was the earliest growth I have yet had to treat by X-rays, being confined to one quadrant of the rectum. The other 5 are all alive and free from growth, and free from a colostomy: one aged 86 is well after two years, 3 aged 81, 77, and 72 respectively for approaching two years, and the fifth, aged 54, was treated only seven months ago.

Of 65 surgically rejected carcinomata of the rectum, 19 disappeared after treatment by million-volt X-rays, or roughly a third of the total. Nothing approaching this has been seen after treatment by 200 kv. X-rays. Several factors probably contribute to the superiority of the million-volt. The gain in depth-dosage, for example, is of the order of 40% for small fields. The isodose curve for a 10-field arrangement at a million-volts shows that for 100 r on each field, the tumour receives 370 r; but at 200 kv., only 250 r (fig. 2). The distribution of the dose is also better with the million-volt, being uniformly high

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where it is required in the malignant region, but falling rapidly among the normal tissues beyond the limits of the growth's extension. It is possible that the quantum energy, which increases as the wave-length shortens, that is, as the voltage rises, may also be a factor of some importance. To give a tumour dose of 6,000 r—and something approaching

# TABLE II.—CARCINOMA OF RECTUM, IRRADIATED THROUGH

I.	A surface dose of 100 r per field At 200 KV.	gives— At 1,000 KV.	II.	To give a tu	mour dose of 6,000 r-	At 1,000 KV.
	250 r Tumour dose 210 r Maximum skin dose	370 r	4	2,400 r 5,030 r	Dose per field Maximum skin dose	1,620 r 3,400 r
	(Helf value lover at 200 km -	9.0 mm Cu)			ime dose in megagramme-r	

this seems to be necessary for the cure of most carcinomata of the rectum—each field must have 1,620 r at 1,000 kv., and the maximum skin dose when the through or exit radiation is added is 3,400 r; but at 200 kv. the field dose has to be 2,400 r, and the maximum skin dose is now 5,030 r, which is at the limit of tolerance and in many cases would result in radionecrosis later. Of still greater importance, perhaps, is the question of volume dose; at 1,000 kv. the volume dose is 41 megagramme-r, a dose which definitely impairs the patient's vitality, but from which recovery occurs in six to eight weeks. At 200 kv. the volume dose is 67 megagramme-r, which is higher than has yet been given in any condition, and which would almost certainly impair the patient's vitality to a critical degree.

I suppose there is nothing more humbling than the daily grappling with the incurable, yet on such radiotherapy has to prove its value, for the surgical results in carcinoma of the rectum are good. If surgical judgment were as perfect as surgical technique, they would be even better, for then there would be fewer recurrences in the operation area. Radiotherapeutic judgment is trained from the other end, as it were, on the advanced and recurrent cases, while radiotherapeutic technique is still developing. Here is the starting point for future advance. In the treatment of carcinoma of the rectum, as of cancer in general, the best interests of the patients can only be served by constant collaboration between surgeon and radiotherapist; with that collaboration we may soon have the early and operable case cured without the deformity of a colostomy.

Mr. A. Dickson Wright: Intractable pain in the later stages of inoperable carcinoma of the rectum, whether from recurrence after removal or from an inoperable primary growth, often appears in patients who have still a considerable time to live and it is really amazing how well these patients look and how much useful work they are still capable of doing before a lethal complication appears. Once the pain has got a grip the patient is quickly useless as a member of the community and a burden and sorrow to those around him, whether from drugs or the lack of sleep undermining his health. It has been very wisely said that surgery directed to the relief of pain is responsible for some of the greatest surgical mistakes because judgment is inclined to weaken under the pressure of the patient's clamour for escape from his agony. It is well, therefore, to exercise the greatest care in the selection of cases for pain-relieving operations. The pain of rectal carcinoma is not a visceral pain as a rule but due to extension to the more sensitive organs in the vicinity such as the anal canal, bladder, prostate and sacral plexus and bones of the pelvis. The pain is generally felt in the latter case in the sacral and perineal regions, in the groins and down the back of the thighs and is of such an unendurable quality that even the strongest characters soon break down under it.

Several procedures have been proposed for the relief of the pain apart from palliative colostomy. (a) The division of the pre-sacral nerve. The opportunity to do this is generally taken at the time of the palliative colostomy, it adds nothing to the risks of the operation and forestalls visceral pain from the rectum and possibly pain which may develop later from vesical and prostatic extensions of the growth. It is no help to somatic pain which may later develop.

(b) The Dogliotto procedure. In my hands this treatment has not achieved the success which on theoretical grounds it should provide. Lumbar puncture is made about the 2nd or 3rd lumbar space with an unbreakable nickel needle and then after the needle is satisfactorily in position the patient is postured by regulating the table so that the posterior nerve roots transmitting the pain lie above the point of the needle. One cubic centimetre or less of alcohol is then introduced slowly to avoid currents and if the injection is satisfactory then a warm sensation is felt in the region where the pain is experienced and by pin-testing this area is found to be anæsthetic. The patient remains in the same position for half an hour to allow the alcohol to be absorbed and is then kept in bed for twenty-four hours. The procedure can be repeated after a few days to stop the pain on the other side. Failure to achieve relief of pain may lead to reckless injections with resultant loss of sphincter control.

(c) Chordotomy is the most satisfactory of all the procedures that I have tried. It is reserved for the younger subjects with good reserves of strength. Laminectomy is done at the summit of the dorsal convexity. The space provided by the removal of the laminæ of D. 5 and 6 gives sufficient access to the cord. After exposing the cord two light stay sutures are passed through the ligamentum denticulatum after division of two of the denticulations and by traction on these the cord is rotated so as to display its antero-lateral region. The tough pia is sectioned from the denticulate ligament as far round as the anterior roots, i.e. about 45 degrees of the circumference. I prefer to snip the tough pia with fine scissors like de Wecker's iris scissors and then divide the substantia of the cord to a depth of 0.5 cm. with a marked Graefe's knife. The section is repeated an inch higher on the opposite side. After operation, retention of urine develops for a short time and so does some pyramidal weakness, but these disappear very quickly. The relief from pain is instantaneous and if the operation is done under local anæsthesia can be checked at the time before the dura is closed. Following the operation all pain-killing drugs can be dropped and often the patient becomes fit for some kind of work.

Dr. Ffrangcon Roberts: A significant feature of this discussion is that so far no mention has been made of radium, an omission which reflects the general experience that in this part of the body as in so many others radium has proved a failure. X-ray treatment therefore remains the only means left to us of exerting any direct influence upon the growth. In such a slowly growing tumour as rectal carcinoma, where the disability is mainly one of discomfort and inconvenience it should be our aim to enable the patient to live as normal a life as possible and to preserve his working capacity.

The routine performance of colostomy, even when obstruction does not threaten, has long been the established practice on the quite unsubstantiated ground that the rate of growth is thereby slowed up. The resulting disadvantages to the patient hardly need

The question therefore is, whether X-ray treatment can improve the condition to the extent of making colostomy unnecessary. My results show that it can, provided that the tumour is subjected to a sufficiently large dose, an end which is achieved by the method

of multiple small fields which I have advocated for some years past.

Out of 35 cases, of whom 5 could not be followed up, one is still in full working capacity after over six years, his bowels being opened regularly twice a day. Two others are in a similar state after more than five years. A fourth has recently died, aged 72, after completing five years, despite the fact that he had had symptoms for a year before treatment was begun. Taking into account that 10 of the 35 were in an advanced state when first seen these results speak for themselves.

Mr. E. T. C. Milligan: The surgeon measures the extent and the severity of his operative measures against the extent of the disease and the patient's strength. One trained in the operation of perineal excision classifies patients as inoperable when he finds the disease beyond the scope of his operation. The surgeon trained only in the more severe abdomino-perineal operation will consign certain frail and elderly people to inoperability where the less shock-giving operation of perineal excision would be successful. Frail patients who would survive as operation with a 7% mortality, which the perineal

resection carries, would succumb to the one with an 18-25% mortality.

To-day there is happily another procedure which will not only reduce the number of inoperable cases in the hands of skilled operators, but will decrease the numbers labelled inoperable: I refer to the operation of simultaneous combined excision of the rectum. Because of the division of the work by two surgeons and consequently the shorter time expended in the operation, the area of the operation can be extended, time-consuming complications overcome, and frailer patients submitted to the procedure. More surgeons throughout the country are now acquiring the skill and practice required by this simpler and shorter procedure. Surgeons at a younger age master its technique without facing the inevitable high initial and occasional mortality. They learn separately the perineal and abdominal parts. More patients will now be submitted to and more will survive the operation. In the beginning the abdomino-perineal operation had a mortality of 40%, It is now 18%.

Palliative removal of the rectum.-Perhaps the worst symptom the patient with carcinoma of the rectum has to face is tenesmus, i.e. continual rectal discomfort or pain, and repeated desire to pass mucus. To relieve or forestall this torment it is good practice to remove the rectum. I believe that great risks should be taken to give this relief even with frail patients. It can be done advantageously where malignant extension in the gland chain or in the liver is beyond the scope of radical removal. Removal of the rectum might well be considered also where the extent of local spread prevents complete local removal of disease. It may be less disturbing to a doomed patient to suffer local recurrence than to have rectal tenesmus. Removal of the rectum means cutting off the nerve supply as well as stopping the persistent and distressing defacation desire. Palliative removal is also merciful when the sensitive skin of the lower third of the anal canal and the skin of the anus are involved.

The effect of operability on the patient's mind and life.—Operation means a way of freedom and escape from the fundamental fears of man connected with his security, comfort, vocation and existence, centred round his growth. If we remove the growth

we remove these fears although the mind takes longer to heal than the body.

Inoperability.—If a patient knows he has a growth and that it is inoperable, who knows what groundless fears haunt his imagination unless he is willing and has the courage to discuss them? Confidence and trust in the surgeon will help him to bring out unexpressed fears.

Dr. Phillip Flood: In considering a tumour for X-ray treatment there are two factors which influence the dose and plan of treatment: the histology of the tumour and its accessibility. On both these counts carcinoma of the rectum is unfavourable. Histologically, the high degree of differentiation of the tumour cells indicates a relatively low radiosensitivity and, therefore, the necessity of a high total dose to the tumour. This aggravates its second disadvantage, namely its inaccessibility. It is in overcoming the second factor and so rendering a high dose possible, that most progress has been made

in recent years.

This progress has been made principally in three ways, first higher kilovoltages. Voltages of from 400,000 to a million are now practical and in clinical use, and have considerably increased the dose that can be given to the tumour. Secondly, and more important, is greater accuracy in beam direction. A dose of from 6,000-7,000 r in approximately six weeks will be required; if this is to be achieved it must be limited to as small an area as possible; by the use of small posterior fields directed obliquely the area receiving this high dosage can be limited to the site of the tumour, provided the fields are set and directed with accuracy. The third direction in which progress has been made is in greater accuracy of dosage measurement which enables a higher dose to be given with safety.

There is another method by which a localized fixed tumour of the rectum may be treated; this is by surgical exposure to render it accessible to irradiation by a tube of short focal skin distance. This method has so far hardly been attempted in this country in rectal cases, although it has been used in the treatment of other deep-seated tumours such as those of the bladder and larynx. Its advantage is that a very big dose can be given and restricted entirely to the tumour. Professor Chaoul published a short series of rectal cases treated in this way before the war, and though his cases would be considered operable cases, his method might be applied to some rectal tumours, especially

those considered inoperable on account of their fixation.

Carcinoma of the rectum which is inoperable on account of extensive pelvic metastases, or metastases outside the pelvis, can only be treated palliatively; the principal indication for X-ray treatment in such cases is to relieve pain due to the pressure of tumour masses. Only the minimum dose required to relieve pain should be given, and if relief is not then obtained treatment should not be continued. Again only a small dose is required to arrest or diminish hæmorrhage and discharge. The radiologist should not treat hopeless cases simply as a placebo.

Mr. O. V. Lloyd-Davies: In considering inoperable carcinomata of the rectum every effort should be made to reduce the number of cases at present regarded as inoperable. Mr. Wilfrid Adams has stated that two-thirds of the cases seen at Bristol are inoperable whilst at St. Mark's Hospital approximately 70% are considered suitable for excision.

The solution to the problem lies in the popularization and adoption of the simultaneous or synchronous combined excision. By this method the difficulties are shared by two operators with the result that surgeons of average experience are enabled to perform Combined Excision with a greater assurance of success. In addition surgeons of specialized experience are able to operate on many cases which would be regarded as inoperable by the most expert surgeons working alone.

We have now at St. Mark's a growing number of cases with firmly fixed tumours which have benefited by operation. Moreover it is particularly satisfactory to be able to record that the factor of fixity in the majority of these cases is perirectal inflammation, so that

the prognosis is often good.

The growth of team work in all large surgical centres should enable the synchronous combined method to be more extensively used and many more patients will benefit from a radical excision instead of being declared inoperable.

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# Section of Neurology

President-George RIDDOCH, M.D.

[May 21, 1942]

#### DISCUSSION ON TRAUMATIC EPILEPSY

Major Hugh G. Garland: The term "head injury" covers a multitude of different pathological conditions which have trauma as a common denominator but which have little else in common, especially as regards their epileptogenic properties. It is time that some of these problems were settled, for besides their academic importance there is the return of war injuries, the increase in the number of road accidents (which has been followed by a multitude of medico-legal problems), and the new therapeutic approach to this type of epilepsy offered by modern neuro-surgery. A good deal of what is written about traumatic epilepsy is only the result of clinical impression and of speculation. Review of the literature on any aspect of epilepsy is no light task as it seems there

have been at least 2,000 papers written in the last twenty years alone.

One of the best recent reviews of epilepsy following a G.S.W. is that of Ascroft (1941), a paper based on a follow-up of 317 cases from the records of the Ministry of Pensions; all these were casualties from the last war. In this group no less than 34 per cent, have developed epilepsy, a finding which is surprising in view of the previously quoted incidence of 4.5 per cent. in 18,000 cases of G.S.W. This latter figure is frequently found in the literature from 1921 onwards (Sargent, 1921; Stevenson, 1931), and is also obtained from Ministry of Pensions records. Ascroft's group was selected by him only to the extent that the notes were complete, and all his cases were presumably included in the larger series. The discrepancy is not due to the late onset of fits, as Ascroft found that most of the cases developed epilepsy within the first few months. Dr. Prideaux (1942) thinks it is partly due to the fact that the less severe cases had their claims settled early (7,600 by 1923) and presumably these cases were at that time suffering neither from epilepsy nor any other serious symptom. If this is the case Ascroft's group is selected to the extent that it consists largely of the more severe injuries; it is, however, almost certainly a maximal figure. Ascroft's series includes a variety of different pathological conditions and he has analysed his results accordingly. The effects of a G.S.W. are frequently localized and it is often the case that a severe local lesion of this type is not associated with loss of consciousness, though there is sometimes such loss after an interval (Eden and Turner, 1941); there may be a scalp wound only, or underlying this there may be severe cerebral contusion with or without fracture or penetration of the dura, or there may be a compound depressed fracture with laceration, in-driven bone, metallic or other foreign bodies, as well as sepsis; the end-result of such injuries also includes such differing conditions as scars, cysts, aerocele, abscess, &c. Ascroft's figures show that epilepsy occurred in 24 per cent, of those with scalp wounds only, but clearly there must have been brain damage in these cases which was unsuspected at the time. The incidence of fits was twice as high when the dura was penetrated. The presence of foreign bodies did not appear to increase the development of fits (unlike Wagstaffe's findings, 1928), but epilepsy was twice as common after there had been sepsis, whether the dura was opened or not. This high incidence of epilepsy after gross localized lesions is perhaps not unexpected when one thinks of the incidence of epilepsy in other gross and localized brain lesions of non-traumatic pathology. According to Penfield (1939a) fits occur in 44 per cent, of all supratentorial tumours. I think the incidence of epilepsy after recovery from a brain abscess is not less than 50 per cent., just as epilepsy is a common symptom in the acute stages of brain abscess, in fact a frequent presenting symptom in metastatic abscess. We can say at this stage that epilepsy following a G.S.W. is now well known. It is associated with a gross pathology, has opened up a promising surgical therapeutic field, and forms that subdivision of traumatic epilepsy about which there is a maximum of fact and a minimum of speculation.

Epilepsy following other varieties of head injury is much less clearly understood. These include injuries known as "closed" or "blunt" injuries and are those commonly seen

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in civilians; they usually result from road accidents, from falling on the head and from blows from falling objects, usually of low velocity. This is again a mixed pathological group but certainly in cases without penetration of the dura there tend to be more diffuse and smaller brain lesions, gross focal lesions being very much less common. At the same time it is probable that a number of focal lesions are overlooked in this group owing to inadequate clinical examination in the acute stages. It is largely on this type of civil injury that most of the figures relating to traumatic epilepsy are based, and, especially in the older literature, there is little attempt to subdivide the cases according to severity or type of injury. That such injuries may be followed by epilepsy is accepted but to what extent the epilepsy is the result of the injury is less certain. The majority of these cases die a long time after the injury and after epilepsy has been present for years; post-mortem examination of the brain is rarely made and is usually inconclusive and, unlike the case of G.S.W., observation of the brain at operation is rare. The problems, therefore, have to be approached in other ways, the most important of which appears to be statistical analysis. Many series of cases have been followed up over long periods, but most of these are unsatisfactory, and it will not be until well-documented records of a large series of cases, such as that of Russell (1932), have been followed over years that accurate figures will be available. One of the most reliable of recent figures is that of Rowbotham (1942), who found epilepsy in 2.5 per cent. of 450 cases of injury of the "blunt" type. He regards this as probably the upper limit, the lower being Feinberg's (1934), who found epilepsy in 0·1 per cent, of a remarkable collection of 47,130 unselected cases of head injury. This latter figure is all the more striking in view of the fact that epilepsy is said to exist in 0.5 per cent. of the population of any country; if this be true Feinberg's figure can only show that a head injury confers a considerable degree of immunity to epilepsy. Russell (1934) found epilepsy in 3.5 per cent. of 200 cases within the first eighteen months of the injury and as Russell's and Rowbotham's cases were obtained from very similar sources this figure of about 3 per cent, is probably somewhere near the truth; but Kinnier Wilson (1940) quotes figures varying from 3.6 per cent. to 21 per cent., while Symonds (1935, 1941) regards epilepsy as being rare after this type of injury. These varying figures can only mean that the cases are in some way selected and that different authors are not discussing the same problem. I think it will be generally accepted that a single cerebral concussion is at least unlikely to be the sole cause of epilepsy, or even to be an important factor in its production, and such cases have no doubt diluted the figures of some observers. In his small series of epileptics Rowbotham found a significant preponderance of severe injuries. Here again, however, there is little agreement as to what constitutes a mild or a severe head injury and for this reason I do not think that further analysis of older published records will be of any value. Suffice it to say that the highest incidence claimed is about 20 per cent. and the lowest a good deal less than that of epilepsy in the general population; and that it is at least very probable that the first figure relates to a selected group of severe injuries and the second is diluted with many trivial cases.

Another method of statistical approach to the traumatic factor in epilepsy is to record the incidence of previous head injury in an unselected group of epileptics. Here again there are difficulties as it is usually impossible to confirm the history and, still more, the details of the accident. Textbooks usually dismiss this subject by saying that a history of injury occurs in less than 5 per cent. of all epileptics. I have analysed a group of 2,600 Service patients; these are selected in that they are all males (in whom a history of injury will be higher than in a mixed group) between the ages of 18 and 50, the majority between 20 and 35; they were all referred to me as falling in the "neuropsychiatric" group. There were 244 cases of epilepsy, of which 77 per cent. appeared to be idiopathic (Table I). Of the remainder there was a history of head injury prior

TABLE I.-CAUSATION OF EPILEPSY.

			Number of cases	Percentage
Idiopathic epilepsy			190	77
Mixed symptomatic	group	000	15	17
History of trauma	* * *		39	16
Total			244	100

to the onset of fits in 16 per cent., the remaining 7 per cent. being cases of cerebral tumour, syphilis, or cysticercosis. This is a surprisingly high figure, which would have been lower had not leading questions been asked about previous trauma; unfortunately. I have no suitable control group. It does not, of course, follow that the injury is in any way related to the epilepsy, but certain facts suggest that in many cases it was of importance. It is generally accepted that idiopathic epilepsy starts in childhood or adolescence and, while there may be some disagreement as to the upper age limit for

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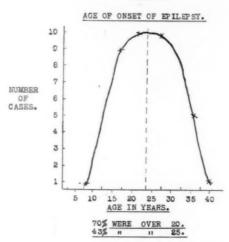
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the onset of idiopathic fits, many put it at 20, and probably most at 25. In my group of cases 70 per cent. had their first fit after the age of 20 and 43 per cent. after the age of 25 (Table II). These figures suggest very strongly that most of the cases were not

TABLE II.



of the idiopathic type, and there was no evidence of any pathological condition other than the previous trauma. In idiopathic epilepsy there is a family history of fits in about one case in five; in 34 of my cases where the information appeared to be reliable there was a family history in only 4, but these figures are too small to be significant. Assuming that the injury has been a factor in these cases it is interesting to classify the injuries according to severity. Of the 39 cases one man had been a boxer and had had multiple slight injuries; I have subdivided the remaining 38 into 3 groups, choosing arbitrary limits; a post-traumatic amnesia (P.T.A.) of less than half an hour is called a "slight" injury, a P.T.A. of half to three hours "moderate" and more than three hours "severe" (Table III). It will be seen that there is a strikingly high incidence of

TABLE III.—SEVERITY OF HEAD INJURY.

Severity			Number
P.T.A. under } hour	 ***		of cases
P.T.A. under 3 hours	 	 *	8
PTA more than 3 hours			98

severe injuries, which is again at least suggestive that the injury is an ætiological factor. It is generally accepted, and in the case of G.S.W. is certainly proved, that the interval between the injury and the onset of fits may be anything up to a number of years, but here again there is considerable disagreement. Foerster and Penfield (1930) in a short series of cases found an average latent period of five and a half years, with limits of five months and fourteen years. On the other hand Ascroft found the latent interval to be much shorter; he found the commonest onset was within the first month, though there were extremes of a few hours to twenty years, and Russell (1942) thinks the late development of epilepsy in closed injuries is rare, i.e., after two or three years. Table IV

TABLE IV.-LATENT PERIOD.

	Years					Cases
Under		***	***		***	24
	1- 3	***		***	***	4
0	4-10				0.00	- 4
Over	10			0.00	000	6

shows the interval in my group of cases; this varied from a few weeks to eighteen years, but the large majority started within the first year. With regard to the longer latent

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intervals, it is interesting that Penfield (1939b) has found evidence that cerebral scars may sometimes increase in size over a number of years. I might add that an "average" figure representing the latent period, when taken from a group varying from a few weeks to many years, is of no significance whatever. In reviewing these cases from the point of view of whether the injury was a causal factor or not one can, therefore, say that in the majority of cases the age of onset of epilepsy was later than is usually seen in the idiopathic form, that the severity of the injury was in most cases considerable and that the latent period was usually short; a family history was uncommon and there was in no case evidence of any other further causal factor. It is interesting that trauma in this group of cases was much commoner than all other causes of symptomatic epilepsy, though this, no doubt, was largely the result of the age group under consideration.

Taking traumatic epilepsy as a whole, irrespective of the type of injury, it is interesting to study the clinical varieties of fits. The common idea that head trauma tends to be followed by Jacksonian fits is very wide of the mark and nearly all authors are agreed that much the commonest attack is a generalized convulsion. At the same time there is frequently an aura indicating the focus of onset, as in any other type of epilepsy. It has often been observed that other variants are uncommon, for example, Kinnier Wilson (1940) says: "It is curious how seldom petit mal or any epileptic variant is either ascribed to injury or evoked by it." Major fits occurred in all my cases and there was no example of Jacksonian attacks; psychomotor attacks co-existed with major fits in 2 cases and minor with major attacks in 3. The electro-encephalogram (E.E.G.) may ultimately solve this problem. For example I am not sure whether the characteristic E.E.G. of either petit mal or psychomotor epilepsy is ever seen after a head injury. If not it may be the case that trauma does not produce fits of these types and that in cases where they occur the trauma may not have been a causal factor, or may perhaps have precipitated fits in a potential idiopathic epileptic; but here again there is disagreement as to the frequency of variants and Symonds (1935) believes the minor attack to be a frequent early manifestation of traumatic epilepsy. This aspect of the problem needs a good deal of further investigation in the light of recent advances, as it may be the case that attacks previously called "minor," which presumably means petit mal, may be syncopal, or short attacks of vertigo. Stevenson (1931) actually states that "vertigo" is common in the latent period and Rawling (1922) found that "fainting" occurred in 16 per cent. of cases following G.S.W. The great importance of these diagnostic problems lies in the prognosis in cases where only attacks of a minor nature are occurring, but whatever the final verdict I think there can be no question that by far the commonest attack is a generalized convulsion. This again should not be unexpected as both petit mal and psychomotor attacks must be very uncommon in any symptomatic epilepsy. this respect it is of some significance that such variants have never, I think, been produced by any form of electrical cortical stimulation nor in my experience do they occur after a water-pitressin test.

I have no personal records relating to multiple head injuries. There is no doubt that headache and other common post-traumatic symptoms tend to be more marked and to carry a worse prognosis if there have been previous injuries, and in this respect my one example of epilepsy in a professional pugilist is of interest. The "punch drunk" syndrome seems quite clearly to result from multiple minor injuries and in my case it seemed probable that the epilepsy was so caused.

To assess the influence of trauma in cases of epilepsy following head injury in civilians is to solve the problem whether such are not in fact cases of idiopathic epilepsy, or whether the trauma may have acted only as a precipitating factor. Because of the undoubted lower incidence of epilepsy in these cases, as opposed to G.S.W., it seems clear that pathological processes left behind by such an injury are not so epileptogenic as are the grosser lesions. The development of epilepsy may be entirely a question of the quantity of cerebral tissue damaged, the number of individual lesions, their size, or their position; or it may depend on some other unknown property of the lesion itself. The lesions produced by cerebral cysticercosis are so epileptogenic that there is no recorded case of them existing for very long in the absence of epilepsy (MacArthur, 1942); on the other hand such a gross lesion as disseminated sclerosis has little tendency to produce fits. It has been said that for a head injury to be followed by epilepsy there must be a certain type of brain and that unless the brain is of this type no amount of trauma This may or may not be true but a similar statement would apparently not be true in the case of cysticercosis. Similarly, such differing stimuli as electrical discharge across the frontal lobes, intravenous cardiazol and hypoglycæmia can produce convulsions in any type of brain. On the other hand Lennox, Gibbs and Gibbs (1939) state that there are three times more epileptics in the near relatives of all cases of symptomatic epilepsy than there are in those of non-epileptics (though I doubt whether

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their cases include cysticercosis); this suggests an inherited tendency to epilepsy in all the symptomatic epilepsies. To sum up, therefore, it appears that in the civilian type of head injury epilepsy follows in about 3 per cent, of all cases, but this figure probably excludes simple concussion, and the highest incidence follows the most severe injuries. The fits are almost invariably major in type and tend to come on early, the majority starting within the first year. Whether these cases are due solely to the injury or whether there was a previous tendency to epilepsy, of the type of inherited background that occurs in idiopathic epilepsy, is not yet clear. It must always be remembered that both head injuries and epilepsy are common and that their co-existence will sometimes occur by Further, recent work with the E.E.G. suggests an epileptic tendency in 10 per cent, of the population, which might well account for all the cases of epilepsy following civilian head injuries. At the same time in medico-legal work trauma is as important as a precipitant as if it were the only causal factor.

As traumatic epilepsy so commonly appears within a year of a severe injury it is only to be expected that in the majority of cases there will be such bridging symptoms as headache, dizziness and some form of mental incapacity. I have not sufficient information relating to such symptoms in cases where the epilepsy only supervened after years but I doubt whether their presence or absence is of much diagnostic or prognostic importance; Symonds (1941) finds epilepsy to be more common in those with persistent intellectual impairment or personality disorder, a state of affairs by no means limited to the most severe injuries.

Other important aspects of traumatic epilepsy include the significance of birth injury, which certainly accounts for some epilepsies of early life; the significance qua epilepsy of the site of the lesion; the prognosis, which is not always gloomy but which becomes worse the longer the latent period; and the co-existence of other symptoms, such as dementia, both in relation to diagnosis and prognosis.

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Mr. W. Grey Walter: The clinical statistics of traumatic epilepsy are contradictory and confusing, perhaps because the statistical method is not entirely suitable for studying this problem. It may be more profitable to consider in greater detail the physiological phenomena observed in each case. From the study of electro-physiological data, several facts are available. The first is that the electroencephalogram has shown that the convulsive seizure is only a part of the epileptic picture; persistent electrical abnormalities exist in many epileptics both "essential" and traumatic. The second fact is that electrical abnormalities seem to be much commoner in young patients, being almost invariable in children who have suffered birth injury. Thirdly, the electroencephalogram changes during the convulsion are always the same, irrespective of the cause of the fit. Records of the petit mal type are very rare in the traumatic cases, and it seems most probable that the true petit mal attack is never directly or entirely attributable to injury.

Apart from the short term, and temporary effects of head injury, there is no evidence of any specific effect of trauma in combination with convulsions on the electro-encephalogram, and there seems little hope, therefore, of distinguishing between the latent epileptic and the person in whom the injury was the direct cause of the condition-if such

Further evidence is available from the electrical convulsion therapy, in the course of which it is possible to measure quite accurately with alternating current the convulsion threshold of thousands of patients. This threshold varies very widely from patient to patient, but is fairly constant in each individual. The variation is of the order of 1,000 per cent. Moreover, the threshold can be greatly raised by administering the con-

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ventional anti-convulsant drugs. These facts suggest that convulsion thresholds vary enormously in each individual, and there is some reason for supposing that this is another aspect of E.E.G. data, leading to the idea of specific epileptic liability.

Two cases may illustrate this view. One is a woman who complained of attacks of twitching in the left arm and face which had developed after a comparatively trivial blow on the right side of the head. This persisted despite surgical removal of a part of the cortical area identified through the course of the abnormal electrical discharge which could be observed, during the attack, by the E.E.G. (fig. 1). The histopathological report

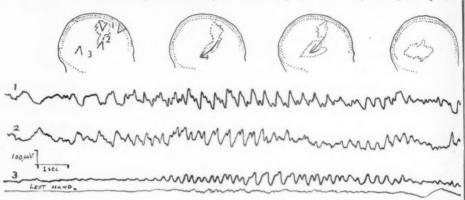


FIG. 1

on the specimen removed suggested that the phenomena here might be due to minor interference with the blood supply to the area by perivascular gliosis, resulting in interference with oxygenation and removal of metabolites. The inference here is that, in spite of the local pathology, the genetic background was such as to discourage spreading of the electrical abnormalities beyond the neighbourhood of the mechanical interference, and, therefore, no generalized convulsion could develop. This would be the tentative explanation of so-called continuous partial epilepsy.

The second case had had a series of major fits in 1938; an E.E.G. at that time had shown bilateral synchronous slow waves of the epileptic type. In 1940 the patient was readmitted in status epilepticus, and shortly died. The last series of attacks were Jacksonian in type, starting in the right hand and face. At autopsy a small glioma was found in the left frontal lobe. Here the explanation would be that a strongly epileptic inheritance favoured the development of generalized convulsions at the earliest stage of the new growth.

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# Section of Psychiatry

President—A. A. W. Petrie, M.D., F.R.C.P.

[April 14, 1942]

#### DISCUSSION ON TESTING INTELLECTUAL CAPACITY IN ADULTS

Major F. J. S. Esher: Experience in testing the intelligence of dull military adults (Précis).—The ideas in this paper were developed as the result of testing in an E.M.S. The work was carried hospital, psychoneurotic soldiers who seemed dull or defective.

out by my colleague E. G. J. Bradford of the Sheffield University, and myself.

It was noticed that amongst inferior adults educational attainments or their lack tended to influence the scoring on some tests, that the personality of the testee required some investigation as it affected the relations between tests, and that the age of the testee had to be taken into account as older men scored, on the whole, poorer scores than the younger. I, therefore, propose to adopt in this paper the viewpoint that to test intelligence alone is of less worth in the case of the adult than it is in the child, whose personality has not yet crystallized.

Procedure.—All men admitted to the psychoneurosis centre were given the Progressive Matrices immediately on admission. Sets A B C D and E were used with unlimited time.

School and employment histories were taken.

The following other tests were given: Terman (Stanford Revision). Performance Battery consisting of Passalong, Form Boards (graded series), Kohs' designs and Knox cubes-all designed or modified by E. G. J. Bradford.

Theoretical considerations.—A man's efficiency in the Forces depends on factors other than intelligence alone. We considered the main factors that made for success to be:

(1) Intelligence. (2) Knowledge. (3) Personality.

Discussion.—(1) We felt that intelligence was the most important of the three and the only one we could hope to measure. This is substantially so even now but I feel sure we are in a better position to speak of the effect of the other two. Intelligence enables a man to analyse his perceptions and to modify his behaviour in accordance with the analysis of the moment. Better intelligence makes for better analysis, though it is, of course, truer to say that the man with the better analytic power has the better intelligence,

(2) Knowledge is the accumulated results of analyses made through the agency of one's own intelligence or that of someone else (e.g. teacher, parent, instructor, &c.), by which it is possible to solve problems similar in their essence to previous ones (not necessarily one's own). The solution of a problem by knowledge rather than by intelligence appears to need the expenditure of less mental energy and is therefore a biological economy. It is an illustration that habitual actions are easier to carry out than new ones, but it must be noted that this method of solving a problem can only be developed if the individual has undergone sufficient relevant experience in the past; hence the immense value of education.

(3) Personality may be thought of as reflected in the attitude a person adopts to his environment (this includes objects real and unreal, animate and inanimate as well as himself). In his attitude he may attempt to mould the environment to suit himself, an aggressive one which may be either constructive or destructive. He may allow the environment to mould him, a passive dependent one; on the other hand he may create an imaginary and false environment because he cannot cope with his difficulties in the real world (difficulties largely within himself).

Each of these three factors plays an important part in the solution of intelligence tests -factors other than intelligence must materially influence the scoring of tests such as those of the Binet type which include not only material which can be solved by intelligence alone, but social situations, educational problems and questions requiring verbal com-

prehension, searches and so forth.

Such tests may test the intelligence of children with success if it is assumed that all children of normal intelligence are interested in and have experience of subjects taught at school, in simple social situations, in the meaning of words, in the use of numbers, &c. It is probably true for the majority, but for some children it is unquestionably not the case, e.g. some are blind or deaf, some chronically ill, and others are encouraged or

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discouraged to do school work. It seems obvious to me that such children will be handicapped in their attempts to pass the tests. Burt pointed out long enough ago that in certain areas 30% of all children attending elementary schools were backward (i.e. educationally below a level 15% less than their mental age).

Dull adults, on the other hand, seem to fall into two main groups. The one contains people who have slowly learned the lessons of years and who can successfully bring lengthy training and tested experience (i.e. knowledge), unlikely in a child, to their own assistance when faced with intelligence tests such as those of the Binet type. The other group contains people whose schooling and subsequent training were of poor quality and who therefore failed to develop what intelligence they had; such folk often not merely stagnate, they lose what little knowledge they derived from school (e.g. reading and writing) and in addition lose the power of exercising their intelligence unless they are urged or helped by someone else.

The first group tend to obtain better scores on some intelligence tests than their real native abilities warrant, and the second tend to fail miserably when they should be able to do better.

Children may therefore be said to acquire knowledge under ordinary circumstances in close proportion to their intelligence and for this reason tests solved by knowledge rather than innate ability are still quite good measures of intelligence. In adults, on the other hand, knowledge which, according to circumstances, may or may not have been acquired, may disturb test scores, hence one's assessments of their intelligence, because it is less clearly related to intelligence than in children. This is especially so in tests of the Binet type, though in other tests, e.g. Passalong, training and experience seem to have less effect.

One has only to think of such subtests as "The difference between president and king", or "Searching for a ball in a field", giving "Difference between abstract words", solving "Arithmetical problems", "Reading and report", Problems of fact and many others, to realize what a help (often an essential help) knowledge is to their satisfactory solution.

The mere fact that, owing to circumstance, some intelligent adults are illiterate makes it impossible for them to attempt certain tests, such as "Reading and report", "Coding a message", "Dissected sentences", &c. We have seen many such men who were often sent to the hospital as mental defectives on grounds of military inefficiency or inability to learn the training given in the Unit. They were clearly different from the typical dull and sluggish mental defectives and were usually found able to pass normally in performance test; in my reports they were described as Scholastic Defectives, and one might say they were Burr's "educationally retarded children" grown up. They constantly gave histories of loss of education for various reasons, the more frequent being chronic sickness, nomadic or difficult parents, problematic behaviour, infantile psychoneurosis or cerebral trauma.

Though many such men were sent for examination as mental defectives (and their school history, unsatisfactory employment and "untrainability" in the Army suggested it) we were seldom in doubt about their diagnosis. On the whole, they were bright in their replies and quick in their movements, they had good knowledge of everyday events and presented a more normal appearance than is seen in "typical mental defectives".

In testing, they scored M.A.s of 9½ to 12 years in the Binet tests, scored normally in the Performance Battery and tended to score normally in vocabulary tests if they were successful in their employment and social contacts, but badly if they were unsuccessful. The socially unsuccessful scholastic defectives were so unable to manage themselves normally that they were easily certifiable as mental defectives under the Mental Deficiency Acts.

Personality expresses itself in the solution of all intelligence tests, indeed any other test. The person whose attitude towards a task is aggressively constructive is, other things being equal, more likely to succeed in his task than, shall we say, the person of dependent type.

In childhood, a certain dependence upon adults is considered natural and is therefore no detriment to the child. In adults, however, an independent and more mature personality is expected and a dependent personality is a real handicap. This is, I feel, an important reason why group tests are relatively unsatisfactory with many adults and why individual tests are essential in such cases for the formation of more accurate assessments of their intelligence.

Inability to persist at a task is a frequent source of failure in testing both adults and children. This is often seen in the hospital when matrix tests have been given. Scores for A and B series may be good, but those for C, D and E far below expectations considering the A and B score. The same effect is also seen in hysterics; they tend to

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develop some of their many symptoms during testing as soon as they realize they are facing a difficulty, namely, the increasing difficulty in solving the test problems; such people may complain that the booklet, the diagram or the room began to spin round after a time, or that they felt giddy, dizzy or faint, or got headache or palpitations. When these symptoms occur they are unable or unwilling to put their best efforts into the test.

When tests are timed, e.g. the Army's 20-minute version of the matrix test, careful and meticulous obsessionals are apt to be penalized for their care and precision. Such men often waste much time checking and rechecking their results before proceeding to the next subtest.

Personality makes its effect more evident in performance tests. In these tests the testee can be observed in the process of carrying out a difficult task under defined conditions; one may see the nature of his mistakes and the way he behaves when he realizes he is baulked and is failing. The tester is more truly an observer when carrying out performance tests than verbal ones. As my colleague, E. G. J. Bradford pointed out in Occupational Psychology, July 1941, 15, 116: "In Binet testing, the initiative is in the hands of the tester, whereas in the performance tests it is mostly left to the subject . . . the tests themselves measure the power of sustained effort in a way that oral tests do not, and hence they have a value apart from that of discovering intellectual weakness."

Scatter in a test has long been known to be suggestive of instability. The same may be said about a correlation between one test and another that is lower than expected. A measure of the homogeneity between scores is the "mean square contingency coefficient". If it is small much scatter and instability may be suspected.

The contingency "C" was 0.55 between two measures of intelligence applied to M.D.s but only 0.05 between the same two measures of intelligence among neurotics. This strongly suggests that maladjustment of personality affects the accuracy of tests as measures of intelligence.

Individuals express their intelligence differently using mainly verbal, abstract-symbolic or practical (visuo-spatial) media. Tests should therefore be chosen to give testees the opportunity of displaying their abilities in the above three media.

It may be well to note here that test conditions should be satisfactory. Disturbance by noise or interruptions, fatigue, hunger, ill-health or unpleasant associations with the testing room, may interfere with a testee's ability to put his best into the test.

In assessing the testee's scores notice must be taken of the fact that men, as they get older, have increasing difficulty in passing tests. Wechsler, for example, incorporates this principle in his tests by having different norms for different ages over 25 years.

In my own figures a preliminary survey showed that it was well marked in Kohs' designs and Passalong tests in men of over 30 years of age. The effect was less in Form Board, Binet, Vocabulary and Matrix tests.

Taking 20-25 age-group as standard, older age-groups scored less and their scores may be expressed as percentages of the scores obtained by the standard group (20-25 years).

26-31 age-group: 32-37 age-group:

 Scored 92% in Matrix.
 Scored 83% in Matrix.

 97% in Form Boards.
 79% in Form Boards.

 97% in Passalong.
 70% in Passalong.

 52% in Kohs.
 44% in Kohs.

 91% in Binet.
 100% in Binet.

This age effect is marked in men of the lower levels of intelligence and is probably less so among the most intelligent. Among the dullest it probably sets in earlier in life. If this is so, it is in keeping with the known fact that mental defectives mature slowly and senesce rapidly and early; thus at 25 years the defective may look 17 whereas at 35 he looks 45.

These observations suggest that the estimation of a man's ability in the Army or industry must be based not only on intelligence but also his standard of knowledge and his personality. Tests, therefore, which are strongly affected by each of the three factors will be more accurately prophetic than tests of intelligence alone. They should also test ability in the various media described above and due allowance should be made for the effect of age.

In the case of adults a figure or value for intelligence alone is unsatisfactory. One must have something that measures or describes the individual as a whole. Ideally, this estimate should enable one to assess a man's ability in any particular sphere.

Mr. J. C. Raven: A psychological test is designed to reveal individual differences of response to a standard test situation. The problems remain constant and a testee's responses are usually evaluated in terms of the mean and dispersion of responses for a

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given population of individuals. In some tests the responses are judged or marked by the psychologist as, in his opinion, revealing characteristic qualities or satisfying a certain criterion of correctness. In other tests a person's actions, judgments or choices are recorded and evaluated without the personal opinion of the psychologist being involved.

Both forms of test are open to criticism. The first type can only be given satisfactorily by a competent psychologist. Results obtained with the second type are apt to be vitiated by influences which pass unobserved. It must also be recognized from the outset that responses of the greatest interest to the psychologist are responses which from the essential uniqueness of their nature cannot be evaluated in terms of the mean or dispersion of responses given by other people.

Dr. Earl once said that no one has yet succeeded in giving a satisfactory psychological definition of "mental defect". I would say no one has yet succeeded in giving a satisfactory psychological definition of "mental ability". Even the word "intelligence" may mean "a piece of information" or "clearness of mental apprehension".

In his work on "The Nature of Intelligence and Principles of Cognition" Spearman (1927) drew a sharp distinction between "reproductive" and "eductive" mental processes, that is, between mental retentivity and intellectual ability.

Intellectual ability may be defined as ability to reason by analogy from awareness of relations between experienced characters. Conversely intellectual defect may be defined as a permanent inability to form comparisons and reason by analogy. "Intellectual defect" defined in this way is not necessarily synonymous with "general mental defect" but it is probably one of the chief causes of proneness to accidents and social failure (Raven, 1942).

The ideal test of intellectual ability is a situation which records under standard conditions either the rate or the accuracy with which a person is able to apprehend the characters of immediately presented experiences, educe relationships between the characters apprehended and conceive logical correlates of the characters apprehended and the relations educed.

We have to infer a person's intellectual ability from a record of his intellectual activity. Past intellectual activity is recorded in a person's general fund of knowledge and information. Present intellectual activity is recorded in the number and kind of problems he is able to solve.

Neither a person's fund of information nor intellectual activity at any given time provides a completely satisfactory method of inferring his real intellectual ability. person's fund of information depends upon retentivity of memory, fluency of recall, upon past experience and education as well as upon his intellectual ability. Deductions concerning a person's intellectual ability from his mental activity at a given time in a given test situation involve all the practical and theoretical problems of "sampling"

A person may do well under test conditions and fail under other conditions, or he may do badly under test conditions and be able to make perfectly sound intellectual judgments under other conditions. Available experimental data indicate that, provided we regard a person's response to a test situation as essentially a response of the whole personality to a single situation, the principles of "sampling" can be applied to psychological testing, but problems are involved which still need to be investigated and in the

absence of adequate data we must be prepared to reserve judgment.

Apart from questions of "sampling" as a psychological method, practical problems exist:

<sup>(1)</sup> Any test used must record a person's intellectual activity under standard conditions. In psychological work this is surprisingly difficult. Even if it were possible to keep the entire test situation constant, people would still vary in their attitude towards the test and in their willingness to co-operate. It is usually necessary to sacrifice some degree of accuracy in the control of a test situation to secure a relatively uniform co-operative attitude on the part of the person being tested.

(2) We cannot record intellectual activity. We can only record a person's actions, judgments or choices (Raven, 1939). Even the simplest judgment involves more than purely intellectual activity, it involves a decision. A decision involves control and conative control involves temperamental disposition. A choice, as used in mental testing, involves search and search involves remembering what one is looking for. If one does not remember what one is looking for, choice becomes chance (Miller and Raven, 1939).

(3) We can only measure the rate or the accuracy of a person's judgments.

Rate and accuracy of judgment vary with health, with practice, with the material used in the test and with distracting or facilitating influences at the time of testing. Even if we are prepared to accept the belief that innate intellectual ability is a constant quality of a person capable of quantitative measurement we are not justified in assuming that the rate or the accuracy of a person's judgments in a given test situation, however carefully designed and controlled, provides an adequate measurement of the person's entire intellectual ability which in its usual meaning includes processes other than those tested.

In choosing a mental test we should bear in mind the purpose for which we want a

test and the reliability of the results we expect to obtain.

<sup>(1)</sup> For the certification and classification of mental defectives' tests of the Binet type are useful.

Tests of this type are really standard psychological interviews by means of which a psychologist is able to indicate in the form of a mental age and intelligence quotient the approximate level of general mental development which a person has reached and the rate at which development is taking place. In the hands of a competent psychologist the results

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obtained can be surprisingly reliable but it must be remembered that a test of this type is essentially an individual test, that it requires approximately forty minutes to administer, that Binet worked with children and that the method and concepts he employed are really only suitable for work with children or with adults who remain relatively childish.

(2) For the purpose of detecting intellectual inferiority amongst adults, choice of test depends largely upon the number of people to be examined and the available number of competent psychologists.

Burt (1937) pointed out that dull children are usually disproportionately backward in school subjects and, in general, non-verbal tests are more suitable than verbal tests. For individual examination performance tests are useful. Where large scale group testing is necessary a simple form of matrix test is useful.¹ The reliability of the results obtained depends upon the type of test chosen. Individual tests are in general more reliable than group tests.

(3) For the purpose of indicating a person's general fund of information and clearness of intellectual judgment verbal tests of intelligence are suitable.

Both individual and group verbal tests are fairly reliable and results naturally correlate well with scholastic ability and ability to follow instructions. A verbal test of intelligence has the defect that one does not know how far success is due to scholastic training, verbal fluency or genuine intellectual ability. A good vocabulary test together with a good non-verbal test of intellectual ability gives more clearly defined results but at present there is no really satisfactory vocabulary test available for group testing.

(4) For the purpose of selecting candidates for special training the type of test employed depends upon the type of training.

(4) For the purpose of steeling.

Ability to benefit from any training which is more than training in the execution of a routine task depends essentially upon a person's ability to reason by analogy and intellectual ability in the sense of capacity for quick, clear, accurate judgment is of primary importance both for the acquisition of knowledge in any class of work and for the appropriate utilization of the knowledge acquired. Where men are to be selected and trained to hold positions in which it is necessary to make decisions or give instructions to other people this is particularly true. I would even argue that clarity of judgment was the essential capacity necessary for holding the respect of other people.

The best method of assessing intellectual superiority in the sense of superior capacity for quick, clear, accurate judgment is to provide an opportunity for a person to acquire a logical method of reasoning and subsequently to test the rate and accuracy with which he is able to apply the method he has acquired. Although intellectual capacity is of primary importance, ability to acquire any particular form of training depends also upon physique, temperament, aptitude, environment and previous training-in so far as these terms can be adequately defined—as well as upon intellectual ability as defined in this

<sup>1</sup>Progressive Matrices 1938 was designed to cover the widest possible range of intellectual development. It was not designed to differentiate clearly between individuals of any one level of mental ability. Used with people of subnormal ability a relatively large chance factor is involved and the reliability of the results obtained is correspondingly low.

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Dr. C. J. C. Earl: What is measured by so-called intelligence tests is the level of organization of behaviour in a standard situation. The ability to behave intelligently requires a mixture of endowment and acquirement of sensorimotor elements as well as imaginal, of non-cognitive as well as cognitive. In the case of adults we face the added difficulty of the enormous modification of behaviour by training, both social and scholastic, by specialized knowledge, habits of thought and many other factors. For this reason tests devised for and standardized on children are quite useless: we must obtain our standards from homogeneous and comparable groups.

Despite these difficulties it is possible to obtain a good working measure of what is commonly called a man's general level of intelligence. But even the theoretical "potential native endowment" of intellect depends on at least three psychoneural properties: the complexity of neural organization; the degree and speed of variability of neural pattern; and the capacity for selective inhibition, or mental synergy. These three processes may be presumed to be more efficient in intelligent than in unintelligent people. But it is a matter of neurological fact that they vary independently even in the normal. Intelligence, however conceived, is not a unit variable. And when one adds all the various factors of acquirement, it is obvious that what is measured by tests of " ractors of acquirement, it is obvious that what is measured by tests of "general intelligence" or by aggregated scores from a battery is a mere conglomeration. Therefore, while it is undoubtedly valuable to have some working knowledge of the general level of intelligence, it is not worth while to spend much time or skill in getting it: this is the only justification for the use of group tests.

The analogy may be drawn between level of intelligence in the psychological field and stature in the physical. Even in very careful physical examinations we do not measure stature accurately because it is not a unit variable, and its accurate measurement gives no important information. If we were to classify on the basis of stature we would find that a mongol, an infantilist, a kyphotic and a man with both legs amputated, would all fall in the same category. What is needed, rather than an accurate measure of total height, is some idea of the proportions which go to make up that total; and also of what other facts about the physical make-up may throw light upon the problem. Accurate knowledge of stature, without knowledge of its components, is practically useless. The position is the same with general intelligence. To know the level, however

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accurately, is of little use. We need to know its make-up. We need to know not only how intelligent a man is, but also how is a man intelligent. The accurate measure of intellectual level, alone and of itself, is merely misleading. What is wanted is an analysis of the actual intellectual function in that individual case, and also of the degree and nature of the integration of intellect with the personality as a whole.

A fully objective or mechanical analysis of intellectual process is not yet possible, for there is no test which cannot be solved in more than one way. This has been clearly shown by Weisenberg and McBride in their study of aphasics. So-called non-verbal tests were not in fact non-verbal for all the cases. The question of what is verbal and what is not can only be settled by careful individual examination. There are wide differences also in the verbal tests themselves. For one man words are pure symbols, for another they are very intimately connected with auditory and kinæsthetic imagery. Many quite intelligent people are curiously bad at pure logical verbal analysis. In the performance field too, even the Vigotsky block test, designed as the perfect measure of pure concept formation, has recently been shown to be soluble on largely perceptual lines, and many highly intelligent people solve it in this way. The analysis of the intellectual process is, therefore, a highly individual affair. Fortunately its really accurate analysis is rarely necessary in clinical work and probably never in personnel work.

In dealing with the integration of the intellect with the personality the influence of acquirement by education and special habits of thought is of great importance. When any cognitive capacity is completely integrated it ceases to be a true measure of intellectual efficiency, for no ability for new learning is needed for its reproduction. For a normal average adult practically no intelligence need be exercised to name the months of the year; what is required here is the product of intelligence which has been exercised in the past. Tests which measure productive intelligence in the child or in the illiterate do no more than measure reproductive activity in the average normal man.

Vocabulary tests are undoubtedly the best measure of reproductive intelligence. An adult's knowledge of the meaning of words is fairly fully stamped in. Vocabulary tests, therefore, give an index of the best level to which an individual has attained—whatever may have happened to it since. Interference with vocabulary only occurs in very grave disorders. The test is limited in value for morons, dullards, those having or having had special reading disabilities, and bi-lingually educated people such as certain Welsh country folk: all of whom score far below their potential. To a greater or lesser extent the same thing is true of all verbal tests. The degree to which they measure productivity, as against reproductivity, is always doubtful, and I know of no verbal test which is a safe measure of ability for new learning in an adult. Such tests, therefore, need care and discrimination in their application.

Performance tests demand new learning and productive intelligence and are an essential for an adequate examination. A combination of verbal and performance tests gives us the relative ability of the individual in the two main psychoneural fields: the verbal-symbolic and the spatial-objective. But performance tests give far more than that, for it is with these tests that we can analyse, albeit subjectively, the intellectual process itself and also estimate the degree and mode of integration of intelligence with the total personality and the degree to which behaviour is influenced by emotional factors.

Performance tests demand a more complete stage of behaviour than do verbal tests. They demand the taking of decisions and the release and control of motor activity; while if they are difficult enough they show the reaction to difficulty and failure. Crudely speaking, the comparison between verbal and performance ability is an index of the degree of interference in intellectual process. But it tells us nothing of the nature of the interference; it does not differentiate between dementia and neurosis; nor does it tell us at what point in the test the interference occurred.

If we are to know about the efficiency of functioning of the intelligence, or to predict behaviour, we must know these things. We must therefore use clinically adequate performance tests, which allow of a really effective observation of behaviour, for such observation is the only present means of filling the gap between the pure mental process which we think or hope to measure and the score on the mental test. The observation of test behaviour allows one to judge not only the degree but the nature of disturbance of function. Overt behaviour is a function of the total organism. The test, though it stresses the cognitive aspect, is in fact always a personality test, and the subject projects his personality into the situation for the examiner to read. We can see at what point, for instance, he uses the conceptual approach, and at what point he thinks perceptually; we can see him turn from planning to trial and error; and we can note whether he profits from the chance successes of that method or whether he uses it blindly. Moreover we can usually form a fairly valid judgment as to why these changes occur. We can note

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whether the subject reacts more markedly to situations of novelty—as do the immature and excitable types—or to those involving intellectual difficulty—which sometimes completely disorganize the behaviour of apparently phlegmatic people. We can see whether such reactions as there may be take the form of excitement or of inhibition. We note that some people lower their scores through carelessness, others through over-caution; that some fail because they are afraid to try, and others because they do not realize the furility of their effort.

The purely cognitive evidence is reinforced by that from the psychomotor field. The essential importance of motor evidence has been amply proved by the work of Luria in Russia, and of Bills and others in America: the contributions of Kretschmer and of Enke are also highly important; yet this qualitative observation of performance test behaviour is at present the only clinically practicable method of assessing this essential

It is obviously impossible in a brief paper to discuss the exact differential diagnostic significance of the various findings. But it is quite certain that the components of behaviour in the individual personality under test are presented for inspection in the test situation. There is the degree and directedness of the subject's striving; there is his excitability or its opposite; his reaction to his success or failure; and his preferred mode of approach. I agree that these tests do not give an accurate measure of the "g" factor or of the power of educing relationships or of abstract thinking, or of any other succinctly definable scientific abstraction. For the matter of that clinical mental testing does not give a really accurate measure of anything—a fact which is raised as an objection to such a mode of approach. But it does give an adequate picture of the behavioural component, it does allow a trained examiner to analyse intellectual process, and it does show the place occupied by intelligence within the personality. Most important of all it does allow of an adequate prediction of behaviour.

#### [May 19, 1942]

# Heredity in the Psychoneuroses (Summary)

## By Felix W. Brown, D.M.

The part played by heredity in the development of the psychoneuroses is one of the fundamental unsolved problems of psychiatry. Psychotherapy entails so much consideration of the environmental situations that it is easy to ignore the possible hereditary aspect of the problem one is dealing with. But the chief difficulty is to define the condition the heredity of which one is attempting to trace. A psychiatric diagnosis for a psychoneurosis can still only be made on symptoms, rather than on ætiology. This introduces the same difficulties as if one were to try to investigate the heredity of a symptom such as cough. There is no neat blood test, as in hæmophilia, or well-established syndrome as in Huntington's chorea, to help in the diagnosis of a psychoneurosis. There is by no means as valid a series of diagnostic criteria as in manic-depressive psychosis. The psychoneuroses are inefficient and escapist reactions of qualities which are inherent in human nature, and which, when not exaggerated, are biologically useful.

For the present purposes the psychoneuroses were considered in three groups, which were defined as follows:

Anxiety states.—Psychoneuroses characterized by some of the somatic symptoms of palpitations, shaky feelings, giddiness, indigestion, tight feelings in the chest, with the mental symptoms of an affect of anxiety, without a preponderance of depression, and various phobias such as fear of diseases, fear of closed places, open spaces, &c.

Hysteria.—A psychoneurosis characterized by definite physical conversion symptoms such as paralysis, anæsthesia, fits, vomiting, blindness, aphonia, and certain mental symptoms such as an affect of indifference and periods of amnesia. This reaction is biologically akin to the possum reaction of a captured weasel or young lapwing.

Obsessional state.—A psychoneurosis characterized by ritualistic acts and thoughts, which the patient recognizes as absurd, and which are not associated with a preponderant affect of depression. This is related to habit formation in childhood and to mankind's primeval desire for ritual and sympathetic magic.

These definitions do not of course ensure that one is dealing with homogeneous material. One may be investigating the heredity of several different conditions under each of these headings.

The other great difficulty is that of separating the part played by heredity from that of environment. A series of statistics might be produced, complete with mean deviations,

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which would only show that children are capable of imitating their nervous parents. This difficulty cannot be escaped except by extensive twin investigation, or by study of children who have been brought up away from their parents. As this latter situation does, however, in itself provide a great environmental stress, this method also is invalid.

#### SELECTION OF CASES

A small group of cases has been taken and investigated thoroughly, concentrating on reliability of data rather than on numbers. 104 cases have been taken comprising 63 anxiety states, 21 hysterics and 20 obsessionals. The age and sex distribution is shown in Table I. These cases have not been selected in any way. They were taken entirely at random from the out-patients satisfying the diagnostic criteria at the Maudsley

TABLE I -AGE AND SEX CHART OF PROPOSITI AND CONTROLS

	An	xiety 1	tate		Hyste	ria	Obs	ession	al state	All p	sychon	eurotics	Controls		
Age- group	ð	9	Both Sexes	0	\$	Both	ď	¢	Both	ð	2	Both	ð	Q	Both
10-14 15-19	2	1	3		1	1	1	1	2	3	3	6		0	9
20-24	7	18	15		6	6	3	*	3	10	14	24	1	5	6
25-29	2	7	9	2	4	6	9	1	3	6	12	18	5	2	7
30-34	10	5	15	1	4	5	1	1	2	12	10	22	4	2	6
5-39	10	6	16	1		1	4	2	6	15	8	23	3	1	4
0 - 44	2	1	3	1		1	3		3	6	1	7	4		4
5-49															
60-60	1	1	2		1	1	1		1	2	2	4	2		2
	-	_	-	_	_	-	-	_	-	-	-	-	_	-	-
Totale	24	90	63	5	16	91	1.5	75	901	5.4	500	104	10	19	921

Out-patient Department, Guy's Hospital, and the Cassel Hospital, so that the cases are not confined to one social class. I knew nothing of the patient's family history before investigating a case. I may add, before starting this work I had a prejudice against the significance of heredity in the psychoneuroses. With the exception of the cases at the Cassel, I was myself responsible for the psychotherapy of the patients. Not only was the detailed family history often helpful in the treatment of the patient, but also the fact that I was treating the patient helped me to obtain excellent co-operation from the patients and their relatives. I did not have the services of a social worker, and all the interviewing of relatives was done by myself. Though much time was thus taken up, the advantage was that the human factor was simplified, the human error being my own, not my own and that of a social worker. In all about 500 relatives were interviewed, and information obtained concerning 2,288 relatives of the patients. In each case a diagnostic summary of the patient's case was prepared, then a family history from at least one other relative as well as the patient. Details were requested for each first and second degree relative, but needless to say a full account was not always available for each relative. Having obtained the case-histories the next step was to classify all the relatives seen and those about whom accounts were taken, according to their psychiatric abnormalities (Table II).

#### TABLE II.—KEY TO ABBREVIATIONS IN CLASSIFICATION OF RELATIVES.

N	Psychiatrically normal.
An	Definite anxiety state, amounting to social or work incapacity at some time.
Hy	Definite hysteria, paralyses, amnesic fugues, hysterical fits, with social or work
	incapacity at some time.
0	Definite obsessional psychoneurosis, with ritualistic acts or thoughts, causing some incapacity.
D	Manic-depressive psychosis, with suicides, mental hospital admissions, depressive stupor, &c. with incapacity for work at some time. This includes involutional depressive states and purporal depressions.
	Schizophrenic psychosis.
SP	
P	Psychosis of unspecified nature, including general paralysis, senile dementia, and various cases not able to be accurately diagnosed from the data.
AP	Anxious personality, including timid apprehensive personality, excessive worrying phobias not amounting to definite psychoneurosis; obsessional personality, with folio de doute, excessive worry over details; depressive personality with well-marked moc swings. In well-marked cases it is possible to distinguish between these groups but usually these personality traits blend into one another, and often all are present in the same relative.
Alc	Alcoholism.
ARAC	2 HeOROHOM.

# Espices. Psychopathic personality, including odd, eccentric people, paranoid psychopaths, impulsive and quarrelsome people, wanderers unable to settle to any job with any success, unstable psychopaths. Mentally defective. CONTROLS

A series of controls was taken of roughly the same age-groups as the psychoneurotic patients. The controls were selected among the medical patients in the wards at Guy's. They were selected only by accessibility of relatives and information, and by the fact

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of their not being desperately ill. Only 31 controls were taken, but even these are sufficient for some purposes. It was not as easy to investigate the controls as the psychoneurotics for several reasons: (1) I was not the patient's physician and the same contact was not always able to be made. (2) For some curious reason these patients and their immediate relatives knew and cared less about their remoter relatives than the psychoneurotics. (3) These patients and the other informants seemed to have less insight into personality traits than the psychoneurotics and could not give as good a history of other relatives. In some cases, however, I happened to pick on the one normal member of a psychiatrically very abnormal family, and usually here a good history was obtained. This may of course mean that if a lot is known about a family, psychiatric abnormalities will always be found, but my impression is that psychoneurotics and their relatives give a better account of personalities than the normals. These controls cannot of course be regarded as typical of the general population, because they were all ill, but it was hoped that in respect to psychoneurotic incidence they could be regarded as at least something with which to compare my results. The illnesses from which these patients were suffering were conditions such as tuberculosis, heart failure, &c. in which there is considered to be no neurotic trait. An interesting point emerges not directly concerned with the present subject. This is the part played by psychobiological situations in determining the onset of a physical disease. Many of the patients gave histories of difficulties which they had encountered similar to those with which we are familiar in taking histories of psychiatric cases. However, instead of reacting by a psychoneurosis, they fell victims to a physical disease or their rheumatic heart became decompensated. This is far from the same as saying that these diseases are psychological in origin, but is merely a way of stating the platitude that the chain breaks at its weakest link.

For instance, when in a run-down state after three self-induced abortions in five years and when she was trying to get a divorce from her husband who had deserted her, a 28-year-old woman developed rheumatic arthritis. A pot shopkeeper with a pancreatic cyst developed diabetes after a period of worry and insomnia following the opening of Woolworth's next door, although he had had the cyst for some years previously.

#### STATISTICAL RESULTS

Owing to space limitation it is practicable here to show only some of the tables of results. Influence of position in family.—The positions of psychoneurotics in the sibships of the propositi were charted, so that the number of first children, only children, youngest children, &c. could be investigated. It was seen that the psychoneurotics occur apparently scattered at random in any position in the family. There were but 4 only children among the propositi. Dr. Lewis Fanning has kindly confirmed the random occurrence of these cases statistically. Thus according to the series of cases here examined, the position in family is of no significance in determining whether or not a person will develop a psychoneurosis (the full proof of this cannot be published here). Incidence of abnormalities in the parents of patients and controls.—This is shown in

Table III. It will be seen that 46.8% of the parents of anxiety states are normal,

TABLE III.—INCIDENCE OF PSYCHIATRIC ABNORMALITIES IN PARENTS OF
PSYCHONEUROTIC PATIENTS AND CONTROLS.

		Anxie	ty state	23	Hysteria					Obsess	ional st	ate	Controls	
N	No. 59	% 46·8	Diff. 33.8	S.E. ± 7.7*	No.	% 40·5	Diff. 40·1	S.E. ± 9-6*	No. 20	% 50-0	Diff. 30-6	S.E. ± 9.4*	No. 50	80.6
An Hy O D	27 2 7	21·4 1·6 5·6	21.4	± 5.4*	8	9·5 19·0	17-4	± 5·6*	3 3	7·5 7·5	7·5 7·5	± 3.4* ± 3.4*	1	1.6
S P AP Alc Ep PP	1 22 2 2	0.8 0.8 17.5 1.6 1.6	4-6	± 5×7	6 3	14-3 7-1	1.4	± 6.8	13	32.5	19-6	± 8·2*	8 1	$\begin{array}{c} 1.6 \\ 12.9 \\ 1.6 \end{array}$
PP	3	2.4			42	99.9			40	100.0			$\frac{1}{62}$	99.9

\*= statistically significant figure.

significantly different from the control figure of 80.6%. The 21.4% of parents suffering from anxiety state is also significant.

Significant figures for hysteria are 40.5% normal parents, and 19% hysteric parents. The obsessional show 50% normal, and 7.5% obsessional parents. This is a much lower figure than Lewis obtained, in whose series, in 1936, 37% were obsessionals. This difference is probably due to many cases being counted as obsessionals in his series which would

be included in the present series as obsessional personalities (AP). There are 7.5% of manic depressives in the parents of obsessionals, a significant figure.

Thus in all the three psychoneuroses, there seems to be some evidence of breeding true some connexion between obsessional state and manic-depressive psychosis, and less between anxiety state and depression. There proved to be no significant difference in incidence between mothers and fathers (table not shown here).

Abnormalities in siblings over 15.—These are shown in Table IV. The same tendency appears. In the anxiety states and obsessionals, the proportion of normals is significantly

TABLE IV.—PSYCHIATRIC ABNORMALITIES IN SIBLINGS OVER 15 OF PSYCHO-NEUROTIC PATIENTS AND CONTROLS.

				1420	ALC A		* ****	O 117.45	CO CA CA	ACC MOI				
		Anxiet	y states		Hysteria				Obsessi	onal str	ite	Controls		
N An	No. 140 28	61·4 12·3	Diff. 28 12·3	S.E. ± 5·07* ± 3·03*	No. 52	80 4:6	Diff. 9·4	S.E. ± 5⋅3	No. 36	64·3 5·4	Diff. 25·1	S.E. ± 6.2*	No. 110	89.4
An Hy O D	5 2 2	2·2 0·9 0·9			4	6.2	5.4	± 2·5*	4	7·1 1·8	7.1	± 2·4*	1	0.8
AP Alc	38	9·4 16·7 0·9	7.8	± 3·88*	1 4	6.2			11	19.6	10.7	± 5·3	11	8.9
AP Alc Ep PP MD	8	0·4 3·5 0·4			1	1.5			1	1.8			1	0.8
Totals	228	100:0			65	100.0			56	100-0			123	99.9

lower, 61.4% and 64.3%, as compared with 89.4% in the controls. The 12.3% of anxiety states in sibs of anxiety states, and 7.1% of obsessionals in sibs of obsessionals is also significant. The AP group is also significant in the sibs of anxiety states.

significant. The AP group is also significant in the sibs of anxiety states.

First-degree relatives.—Table V shows the incidence in the most important abnormalities for all first-degree relatives, i.e. parents, children and siblings of psychoneurotic

TABLE V.—INCIDENCE OF CHIEF ABNORMALITIES IN FIRST-DEGREE

							TATE STATE	A A V AND					d	
			,	Anxiet	y states	Hys	teria	Obsessio	nal state	All psycho	neurotics	Controls		
				No.	9/0	No.	%	No.	%	No.	%	No.	%	
N				208	57.0	69	64.5	60	59.4	337	58-8	164	86.8	
An				55	15-1*	7	6.5	3	3.0	65	11.3			
An Hy O				8	2.2	12	11.2*			20	3.5	2	1.1	
0	***	***	***	2	0.5			7	6.9*	9	1.6			
AP	***	***		40.2	16.7	10	9.3	25	24.8*	96	16.8	19	10.1	
D				9	2.5			4	4.0	13	2.3			
Oth	er cor	nditions		22		9		2		33		4		
				_		manner.		_		_		-		
		PT - An	2	nor.		107		1/51		E *** ca		100		

patients. There is significant evidence of similar inheritance, of 15·1% in anxiety states, 11·2% in hysterics, and 6·9% in the obsessionals. There is also a significant incidence of anxiety states, in the relatives of hysterics and obsessionals, and of depressive psychosis in the relatives of obsessionals and anxiety states.

Second-degree relatives.—Table VI shows the incidence of the more important abnormalities in all second-degree relations, i.e. uncles, aunts, grandparents, nephews, nieces, half-

TABLE VI.—INCIDENCE OF CHIEF ABNORMALITIES IN SECOND-DEGREE

					IVE.	MARKA TA TO				
		1	Anxiety	states	Hys	teria	Obsessio	nal state	Con	trols
N	***		No. 533	72.4	No. 207	79-3	No. 178	71.2	No. 251	89-9
An	***		90	2.7	5	1.9	1	0.4	2	0.7
Hy			3	0.4	4	1.5	2	0.8	1	0.4
O		000					2	0.8		
An Hy O AP D	***		87	11.8*	24	9.2	42	16.8*	17	6.1
D			20	2.7*	4	1.5	11	4.4*	1	0.4
Othe	r condi	tions	73		17		14		7	
			_		_		-frame		_	
	Total	ls	736		261		250		279	

sibs, grandchildren. The data of course are not as reliable as those for first-degree relatives. The significant figures are those for depression in second-degree relatives of anxiety states (2.7%), and of obsessional states (4.4%) and for anxious personality in relatives of anxiety states (11.8%) and of obsessional states (16.8%). The high incidence of depression in second-degree relatives is probably due to the fact that they are on an average fifteen years older than the first-degree relatives who have not had time to develop their depressions.

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Twins.—There were four pairs of fraternal twins among the propositi, only one member of each pair being psychoneurotic. One pair was studied in detail. Physically they resembled one another very closely, but one was an hysteric and the other a normal healthy woman. They were brought up together but their biographies showed a gradual divergence of personality. Their finger-prints show no resemblance at all, in spite of the physical resemblance. One can only conclude that they were fraternal twins closely resembling one another physically but not in temperament, although they shared approximately the same environment. This is in itself an argument for an hereditary factor in the psychoneuroses. It also suggests that this factor is not in any way linked with any physical traits; that personality and physique can vary independently. Of the other twins, one pair were of opposite sexes, the other two pairs were of the same sex but dissimilar.

Family histories of Service psychoneurotics.—Table VII shows the incidence of psychiatric abnormality in the parents and siblings of 30 consecutive cases of soldiers, sailors and

TABLE VII.—INCIDENCE OF ABNORMALITIES IN PARENTS AND SIBLINGS OF

30 C	CNS	ECU	LIVE	SERV	ICE	CASES
			Par	ents	Sib	lings
N			No. 37	61.7	No. 125	87:4
An	ll sho	ck"	3	5.0	6	4.2
D			4	6.7	1	0.7
AP	***	***	11	18.3	9	6.3
Alc			1	1.7	î	0.7
	T	otals	60	100.1	143	100.0

airmen who were failing to adjust for psychoneurotic reasons. The data were hastily collected in the course of ordinary work and among Service cases in E.M.S. hospitals. There is a relatively high incidence of abnormality in the parents, especially of depression. The siblings are not very abnormal.

Follow-up of cases.—A postal follow-up was done recently on all these 104 psychoneurotic patients. Of the 63 anxiety states, replies were obtained concerning 28. Of these all had returned to work, 11 were completely recovered, 12 better but with some symptoms, 3 were the same, and 2 had died, 1 of duodenal ulcer and 1 of a stroke. Four were grade 1 in the Services. Of the obsessionals 11 replies were obtained. One had completely recovered, 6 better but still had symptoms, 3 were worse, and 1 had committed suicide. who recovered attributed her recovery entirely to halibut oil. Two were in the Forces graded B, 6 were at work, but in 1 case a schoolmaster had become a fire watcher, 2 were incapacitated. Of the hysterics, 14 replies were obtained, 3 were recovered, 5 much improved, 3 unchanged, and 3 were worse. One was grade A.I. in the Army, 1 had been boarded out of the Army. Six were at work and 6 were incapacitated. In none of these cases did the family history provide a reliable guide to the prognosis of the patient. Some with the worst family history had done best. All these cases had received some psychotherapy, some of them quite intensively. The cases that had done badly had attended most of the available psychiatrists, one bad obsessional had received shock therapy with no improvement. The interesting point about this follow-up is the good prognosis of the anxiety states. The degree of conversion seems to be an index of bad prognosis. It is of course impossible to generalize from such a small follow-up, especially as those who did not reply may all be in mental hospitals, but I doubt it. The obsessionals and hysterics who had done badly did not hesitate to describe their miserable state.

#### Conclusions

In this series, without detracting from the importance of the environmental factor or of psychotherapy, a case is made out for the significance of heredity in the development of the psychoneuroses. The random occurrence of psychoneurosis in the sibships and the cases of fraternal twins are probably the strongest arguments for heredity playing a significant part.

Assuming then that there is a hereditary factor, what is its nature? It is easier to answer this negatively than positively. It is not a recessive, only one case of consanguinity was found. Simple dominance is also excluded; the ratio of first-degree relatives affected, in the aggregate, does not suggest simple dominance, though at times individual family trees can be found where the inheritance looks simple dominant.

There is a great probability that the inheritance of many commonplace human characters is on the lines of variable dominance, where the environment also plays a large part.

With the psychoneuroses, however, we are not dealing with definite diseases, but only reaction types. The clinical classification of psychoneuroses into anxiety, hysteria, and obsessional is arbitrary, though convenient. This classification is supported by the observation that these conditions to some extent breed true, about 15% in anxiety states and about 7% in hysteria and obsessional states. These three conditions also seem to be related genetically to one another and the obsessional state, and to a less extent the anxiety state, and much less hysteria, to the manic-depressive psychosis. They also seem to be related to a more indefinite personality deviation which I have called anxious personality which is in itself not definitely abnormal, but yet which is possessed by most of our patients. To postulate a gene for anxiety state, one for hysteria and one for obsessional, even a variable dominant gene, seems much too simple to fit the facts. Another theory would be that psychoneuroses occur by a certain shuffling of the kaleidoscope of factors responsible for normal personality. The fact that psychoneuroses occur in the relatives of normals to some extent would support this. In some families it seems as though the psychoneuroses have arisen as a result of combinations of factors not in themselves pathological, though the combination proves to be. For instance, a combination of overconscientiousness with low intelligence may well predispose a patient to develop a psychoneurosis, though these qualities separately may not be beyond the range of normality. This theory, however, would not account for the observed greater incidence in the relatives of psychoneurotics, and it is probably not the whole story: I would suggest, however, that the development of, say, an obsessional state rather than an anxiety state depends more on the commonplace personality factors, which are probably themselves variable dominants, than on the specific psychoneurotic factor, if it exists. It may perhaps be that there are one or more pathological variable dominant factors, of the order of constitutional emotional sensitivity, determining whether or not a psychoneurosis can develop in a suitable environment.

The high ratio of similar inheritance obtained in some of the figures for first-degree relatives suggests in fact that the inheritance of the underlying diathesis responsible for psychoneurosis in general is not excessively complex. It may even be a simple variable dominant. If this were so, then the particular type of psychoneurosis may depend on the particular grouping of contributory personality factors, not necessarily in themselves pathological. Some such combined inheritance is most likely to fit such data as exist. It is possible to make a scheme of multi-factor inheritance to fit almost any genetic ratio, but it would be wiser at this stage to let the figures speak for themselves rather than to speculate further. The environment in which these psychoneuroses developed was the peace-time environment, and the stresses were the familiar ones of family and sexual relationships and work difficulties. Psychoneuroses developing in these conditions may be more endogenous than those arising in the acute and extraordinary stresses of war time. It is moreover probable that many of the environmental situations of these psychoneurotics arise as a result of their characters, rather than that their characters are a result of their environment. To split the influence of environment from heredity decisively is at present impossible, but nevertheless from such evidence as we have, heredity plays quite as

important a part as environment in the development of the psychoneuroses.

This work was done with the aid of a grant from the Medical Research Council, whom I wish to thank, especially Towid Munro. I also wish to thank Dr. R. D. Gillespie for his help at Guy's and for initiating this research, Drs. Anderson and Rogerson for their help at the Cassel, and to acknowledge the help of the late Professor Mapother who allowed me to use the Maudsley material. I particularly wish to thank Dr. Lewis Fanning of the Institute of Hygiene for his invaluable assistance with the statistics, and Dr. Eliot Slater for some very useful advice.

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# Section of Otology

President-F. W. WATKYN-THOMAS, F.R.C.S.

[March 6, 1942]

# A Study of the Activities of the Intratympanic Muscles. [Summary]

By F. W. Kobrak, M.D.

In 1925 the author described a series of cases in which deafness of internal-ear origin was associated with middle-ear signs; in this series there were cases of Ménière's syndrome and of pontine and circum-pontine lesions such as bulbar palsies, disseminated sclerosis and encephalitis lethargica. As a result of these observations it was suggested that in the control of the tonus of the intratympanic muscles there was an element provided by the vestibular mechanism. After this preliminary work clinical observations showed that in some cases of genuine cochlear deafness there were signs of middle-ear disease and that

such cases were often improved by treatment of the middle ear.

Following the experimental work on animals of H. Kobrak (1930), Hallpike (1935) and others on the intratympanic muscles (1930-1935) the earlier clinical work was supplemented by the administration of drugs which were known to have effect on impaired muscle tonus; special attention was paid to tetrophan (Schering) a coal-tar derivative. As a result of these observations a clinical relationship was detected between alterations of middle-ear muscle tonus and some varieties of otosclerosis (the "spasmophile" form) and "middle-ear inefficiency" in some cases of cochlear deafness (1938). Further information was given by a new method of testing hearing, which was intended primarily to extend the use of tuning forks in regard to loudness rather than intensity. The results obtained support the possibility of a muscular factor in some cases of deafness. This work (J. Laryng, & Otol., 1940, 55, 405) may be summarized thus: If a tuning fork is struck with a force of constant intensity it is heard for X seconds. It is then struck again, and after a lapse of X seconds is held to the ear. In the normal ear it is generally heard only for a short period, Y seconds. Again the fork is struck, and after X + Y seconds is held to the ear for the third time. In the normal subject it is seldom heard at all; if it is, the third "Z" period of hearing is very short indeed, even shorter than the "Y". In many pathological cases the "steppage" of the periods is quite different, and additional periods are often found.

This "protraction of the hearing period" cannot be ascribed to fatigue; it strongly suggests an active inhibition of hearing, and such an inhibition could be produced most

easily by the action of the intratympanic muscles.

Hitherto the action of the tympanic muscles has been regarded as a damping effect against sounds of dangerous intensity—a protective mechanism. But the animal experiments show an interesting discrepancy; the full effect of the muscle activities, as registered by the contractions, do not come into force until the damping, as shown by the Wever-Bray effect, has passed its climax or is nearly over. This suggests a dual muscular effect—a linked reflex of "protective" and "corrective" damping. It seems possible that the protective damping is more dependent on vestibular stimulation, the corrective damping more on cochlear stimulation. It is not suggested that corrective damping in any way resembles visual accommodation; it is not an adaptation for "near hearing", but it is a mode of response to quickly changing sound intensities. Damping adaptation is slowly developed during the first months of life, and with increasing auditory experience reaches a stage of muscular automatism. For the quickly changing sound intensities of speech and music to be appreciated, a ready flow of change in damping intensities seems indispensable to give elasticity in hearing; and such muscular automatism must be correlated with the vestibular-balanced tone of the intrinsic muscles. It will be realized that there are essential differences between testing hearing for speech, which is more dependent on elasticity of hearing and therefore on the integrity of the tympanic musculature, and testing for hearing of pure tones. Without some corrective type of damping, apart from the gross, protective damping, it is difficult to see how basic perception of music is possible. In orchestral music coinciding piano and fortissimo would only be perceptible, if protective damping changed to corrective damping in some 20 milliseconds.

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It is clear that the participation of the intrinsic muscles in hearing has not only a theoretical but also a clinical significance, especially in some forms of progressive deafness hitherto found refractory to treatment. If there is any interference with the activity of the reflex are which controls the intrinsic muscles some effect on hearing is inevitable. Even apart from the question of corrective damping, hyperexcitability of the are would bring the protective damping mechanism into action for intensities far below the normal threshold of stimulus; this might account for the protracted period of hearing. Moreover cochlear hypo-excitability would be deleterious. Instead of the muscles being thrown into a premature spasm (vestibulogene), the cochlea would be deprived of a valuable protection, and fatigue would come on far more quickly and last longer.

Routine measures of treatment provide a field for research by analysing the detailed effects of such therapy. The assessment of the improvement of hearing by inflation in cases of cochlear deafness without any concomitant middle-ear change needs further consideration. The same applies to the results sometimes obtained in cases of dry perforations by the use of an artificial drum.

The effect of medication as well as of mechanical treatment in such cases needs investigation. So far no direct evidence is available as to changes in the structure of the cochlear nerve in cases of deafness by therapy in the way of arrest of or recovery from the degenerative process, or of regression in the otosclerotic changes in the labyrinthine capsule; but it is hoped that clinical evidence may be afforded by an application of varied forms of the numbing effect. Audiometer tones of highest intensity failed to produce conclusive results. Thereupon, the numbing effect was investigated in the following way: The tuning fork c<sup>4</sup> (Edelmann) was hammered close to the ear over a period of some thirty seconds, until there was a definite sensation of giddiness and pressure in the ear. Air conduction figures of the audiogram pointed to lesions in the organ of Corti. However the figures of bone conduction were not analogous to those of air conduction; they pointed to a second extracochlear numbing effect, which seems to improve, relatively, the figures of bone conduction against those of air conduction. Here, once more, damping activities of the tympanic muscles are suspected. Dual intracochlear and extracochlear effects are suggested to be in operation not only with the experimental shock stimuli of numbing, but also with the mitigated "numbing effects" of ordinary hearing, on which further research is now in progress.

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# Deafness Due to Central Lag

# By W. M. Mollison, M.Ch.

THERE is a type of deafness found especially at the age of 50-60 which is not revealed by the usual tests of spoken words. Slowly spoken sentences may be heard well, but rapidly spoken sentences are not grasped. The first word or two are heard and the rest is lost. The conducting and perceiving apparatus appears to be normal, but the central receptive apparatus is sluggish; that is to say, there is a central lag.

One case is that of a highly intelligent man aged 57, who complained of deafness, saying that he could not hear what was said at committees of which he was chairman. I found he heard quietly spoken words at 18 ft. on each side, but whole sentences he heard only at about 6 or 8 ft. Although he had been working hard he was not at all an exhausted subject. In the audiogram the lowest part of his scale was at 4096.

These cases are characteristic of quite a large number of people. At a Section meeting (Proc. Roy. Soc. Med., 35, 245) papers read by representatives of the R.A.F. pointed out that a great many flying personnel had this loss at 4096. After that discussion I looked at some of my audiograms and found that exhausted cases had a drop at 4096.

A lady aged 54 heard spoken words at 16 ft. on one side and 20 ft. on the other. Here again there was an enormous drop at 4096—very little drop above that.

A man aged 25, a soldier, heard spoken words at 20 ft. on the right side and 18 ft. on the left, but he could not hear his watch on the left side, and he had a marked drop at 4096 in the left ear and a slight drop in the other.

A man aged 40 had some tinnitus, the note of which fluctuated up and down the scale, and certain noises vibrated in his ears. For instance, the music of a band heard with the right ear was quite distorted, but, heard with the left, it was normal. His audiogram, again, shows a drop at 4096, and not much drop until that point is reached.

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A motor-driver had always been very deaf. His upper tone was lowered both by air and bone. Here again there was a drop at 4096-quite a stepping down at that level.

A riveter, aged 27, had been engaged on this trade for three years. His history was that while he was riveting he suddenly noticed that his right ear became deaf. He is now completely deaf in that ear. There is also a drop at 4096 in his left or "good" ear. Is that a danger signal? Should he give up this work

A boy of 14 had a blind right eye due to congenital hæmorrhage. He complained of a tendency to deafness, but heard conversation at 20 ft. with both ears. Bone conduction was normal. But here again there was the extraordinary drop at 4096. The boy's father complained of much the same thing, but the drop was less.

The next case was a lady of 67, who had had some deafness for many years. She heard spoken words at 12 ft. Again there was this drop at 4096.

The last case is another soldier, aged 30, who complained of slight deafness in the left ear. He heard with the right ear conversation at 20 ft., with the left, conversation at 18 ft. His lower tone limit was normal, his upper tone limit on the left side greatly reduced. Here again there was a large drop at 4096.

Discussion.—THE PRESIDENT suggested that the two papers be discussed together in the hope that some member might be able to correlate the curious hearing lag of which Mr. Mollison had spoken with Dr. Kobrak's observations. He thought that they were not so correlated. The function of the intrinsic muscles was primarily protective, and anything that could be done in the way of improving hearing must be regarded more or less as a bonus. At the same time, Dr. Kobrak's paper did afford some most valuable suggestions regarding matters which had never been quite understood. Why occasionally did one find a patient with a patent Eustachian tube who was unquestionably improved by inflation? This did happen, and was not due to a purely psychological effect. Again, there were the odd cases in which a patient's hearing was definitely improved by faradism. That, again, did happen, although in his experience, rarely. There was also the extraordinary effect on the otosclerotic of amyl nitrite or occasionally of excessive alcohol.

happen, although in his experience, rarely. There was also the extraordinary effect on the ofosclerotic of amyl natrite or occasionally of excessive alcohol.

In Dr. Kobrak's paper lay the germ of an explanation of these things.

As to the lag in hearing, the psychological element had to be taken into account, by which he meant in this case the element of guessing. Anybody with a fairly extensive vocabulary, if he heard two syllables of a four-syllable word, would be able to identify the word, but in the case of a sentence only partially heard he was at a loss unless he got the gist of it. That accounted for the phenomenon whereby on someone making a remark, the person to whom it was addressed, having heard it imperfectly, asked him to repeat it, but before this was done guessed correctly what the remark had been. What had happened was that the hearer had picked up a few syllables, and after a slight lag the brain was putting the syllables into the appropriate words into the appropriate sentence. The drop at 400% was a matter of fascinating interest. He himself would regard this drop as a danger signal in the case of anyone working with new to the syllables in the case of anyone working with new to the case of anyone working with new to the syllables in the case of anyone working with new to the case of anyone working with noisy machinery.

Dr. HUGO FREY said that the theory of the function of the intratympanic muscles had suffered over a long period from an analogy between the functions of the eyes and of the ears. Because the eye had undoubtedly an apparatus for accommodation which was worked by muscular energy, one thought that the muscles in the middle ear ought to be an apparatus for accommodation as well, forgetting that analogies as a rule did not teach very much. There were no established facts which would show that such a thing as accommodation existed in the act of hearing, in fact just the reverse. Accommodation could either be an accommodation to intensity or an accommodation to the pitch, if either of them really existed, it would make the full enjoyment of a piece of music quite impossible. How could one take in the full æsthetic impression of a piece of orchestral music, if one could not simultaneously enjoy the high and the low, the loud and the faint sounds, without having to accommodation one or the other. Such accommodation would allow a distinct perception only of a part of the music at a time, and thus be detrimental to the æsthetic effect. With the eyes, one could not look at the same time at a picture which was five yards away and the scenery in the far distance. But with the ear it was possible simultaneously to perceive considerable variations of intensity and pitch.

When one then went on to consider what else could be the meaning of these muscles, he believed that Dr. K-brak was right in suggesting that there was some adaptation of the whole apparatus for hearing. There was no doubt that by the action of the muscles a higher degree of tension and also of pressure could be produced within the middle-ear, and, consequently, transmitted to the labyrinth. It was known by experiments, that if a loud whistling sound was produced, the tensor tympani muscle made a sudden contraction, but such an artificial rritation, as differing from the physiological one, could not teach very much about the normal action of the muscles in the

Dr. KOBRAK said that there was not the slightest contradiction between the opinions which Dr. Frey had expressed and what he had stated in this paper. He had emphasized the fact that there was no accommodation, and the word "accommodation" in relation to the ear should be abandoned. He had also stressed the problem of how it was possible to hear faint lower tones coincidentally with loud higher tones in music. The first stage in the reaction to sound, which came very early in life, was a crude reflex. Then came the finer reflexes, but he thought that without some graduated came very early in life, was a crude reflex. Then came the finer reflexes, but he thought that without some graduated was a similarity, and one could learn to some extent how the mechanism worked. He might have entitled his paper "The Static Functions in Hearing". The most essential was the hearing tonus, and he thought the hearing tonus might come to be regarded sometimes as a differential diagnosis in the case of these new tests. He had now a series of such cases in which he could say that patho-physiological conditions were present.

Major T. A. CLARKE, referring to Mr. Mollison's contribution, said that if his tests had been with a whisper there would have been a more obvious relation between the hearing for speech and the audiometer records. This subject was discussed by Yates in the Hearing Tests Committee in 1928, and later, in the Section (Proc. Roy. Soc. Med., 1929, 22, 1480 (Sect. Otol., 1269). His remarks were based on work describing the phenomenon known as prolonged abklingen and based on the supposition that the defect was a local cochlear one.

Mr. W. M. MOLLISON said he could not agree with the suggestion made by Major Clarke. He thought whispering as a test was bad, and that ordinary conversation should be used.

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[May 1, 1942]

#### DISCUSSION ON BRAIN ABSCESS

Mr. D. W. C. Northfield: The management of cases of brain abscess.—This series of cases of abscess of the brain comprises only those in which the infection has apparently spread from the ears or from the paranasal sinuses. Consideration of difficulties of diagnosis and treatment is followed by an outline of the method of treatment now adopted, and which is giving more hopeful results than former methods.

In the first group of cases in which differential diagnosis has proved difficult, the presence of acute suppurative meningitis has been a stumbling block. Lumbar puncture easily confirms its presence, but whether or not an abscess is also present may be uncertain. During the early stages of abscess formation the cerebrospinal fluid commonly contains a high cell count (predominantly polymorphonuclear) and a moderately raised protein content, but the chlorides are not reduced. The fluid is sterile, and the pleiocytosis There is no general meningeal steadily diminishes with a change to lymphocytes. infection although this may develop in unfavourable cases, with a corresponding increase in cells and fall in chlorides. Complementary to these changes in the cerebrospinal fluid is the clinical picture. In all expanding or space-occupying lesions in the cranium a detailed and accurate history is of great importance, in order to detect the chronological sequence of symptoms indicating increased intracranial pressure and spreading focal disturbance of neurological function. Neurological examination yields the necessary objective evidence of a localized brain lesion. Headache, vomiting and diplopia are common to meningitis and abscess, but drowsiness and mental obfuscation suggest an abscess, and restlessness, delirium and severe toxemia usually accompany meningitis. Persistent and early vomiting is often a symptom of an abscess in the posterior fossa. There may be little or no pyrexia or increase of pulse-rate, and indeed a bradycardia is a valuable sign of abscess, but in meningitis the temperature and pulse-rate are usually much raised. The importance of aphasia, hemianopia and other localizing paralytic signs need not be stressed. A leucocytosis in the blood is seldom present in an uncomplicated case of brain abscess, although usually considerable in meningitis,

When "focal signs" are found in a case of meningitis, if they are not due to an intracerebral collection of pus, they may be caused by a loculus of leptomeningeal fluid.

In a girl of 20 radical mastoidectomy was performed for left chronic otitis media; the lateral sinus was opened and had to be plugged. Drowsiness and dysphasia rapidly developed and three days later the wound was reopened and two drams of pus were aspirated from within the cranium in the left temporal region. When she came under my care, poor co-operation prevented a satisfactory examination, but slight right-sided pyramidal signs developed and the cerebrospinal fluid was purulent and contained streptococci. The temporal region was again explored: no pus was found within the brain and the ventricle was easily tapped making a brain abscess highly unlikely. There was, however, a gush of purulent cerebrospinal fluid from between the brain and the cranium. She died; autopsy revealed no abscess but diffuse suppurative leptomeningitis. The "focal signs" in this case were clearly due to trapping of the cerebrospinal fluid around the temporal lobe.

In another case, in which a cerebellar abscess was suspected owing to the presence of localizing signs, an exploratory operation revealed no abscess, but a considerable quantity of cerebrospinal fluid was evacuated from the region of the cerebellopontine angle, and the boy made a rapid recovery.

Adams McConnell (1937) has described similar cases of loculation of cerebrospinal fluid in the posterior fossa; in his cases, symptoms of raised pressure and "focal signs" were associated with a cerebrospinal fluid of normal content.

Otitic hydrocephalus-now familiar to us by reason of the writings of C. P. Symonds -has been rare in my experience. It is usually to be distinguished from abscess by the comparative well-being of the patient, in spite of headache and perhaps vomiting, and by the absence of abnormal neurological signs apart from papilloedema. Changes in the cerebrospinal fluid are variable but generally of a mild order.

Girl aged 13 years: left chronic otitis media had been present for a year, and symptoms of increased intracranial pressure for about a week. There was papilledema but no convincing focal signs. The cerebrospinal fluid contained 20 lymphocytes per c.mm. and 40 mg, of protein per 100 c.c. Compression of the right jugular vein gave a rise in cerebrospinal fluid pressure, but on the left side there was no rise. Lateral sinus thrombosis with otitic hydrocephalus was diagnosed, but the patient's continued deterioration led me to explore the temporal lobe, and no abocess was found. Mr. Keogh explored the mastoid and found an extradural abscess and thrombosed sinus and again explored the temporal lobe with negative findings. Recovery followed a stormy illness, complicated by a brain fungus and a cerebrospinal fistula through the mastoid wound, giving rise to a quadrantic hemianopia. The papilledems subsided after about a month

In another group of difficult cases, the pathology does not yet seem satisfactorily ex-plained. The clinical picture mimicks closely that of cerebral abscess, but no abscess is found on exploration, and the patients usually recover spontaneously. These may be cases of brain cedema due to thrombosis of cortical veins, although in a case under my care there was no abnormality of those veins exposed by craniotomy. Dott in 1940 described to the Section of Neurology similar cases which he considered were due to a non-suppurative encephalitis. Cortical venous thrombosis can be recognized with greater certainty when the affected veins drain the central areas of the cortex, the characteristic feature being epilepsy with sudden hemiparesis. The cerebrospinal fluid may contain an excess of cells and protein-and in severe cases it may be blood-stained.

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At times it may be difficult to distinguish between an abscess and a tumour; the presence of otorrhoa may be misleading.

Female aged 40 years: right otorrhoea since childhood; several years bouts of severe headaches and vomiting with right homonymous visual hallucinations. In one such attack there was stupor for several days, when a mastoid operation was undertaken in order to exclude an extradural abscess. When she came under my care, there was drowsiness, neck rigidity and a positive Kernig: no papillocdema and the visual fields could not be tested; other neurological signs had no localizing value: cerebrospinal fluid, 440 mm. pressure, 5 cells per c.mm. and 60 mg. protein per 100 c.c.—compatible with s chronic abscess. Ventriculography indicated a right frontal tumour, and a meningioma arising from the sphenoidal ridge was removed at subsequent operation.

More common has been the finding of an abscess when it has been little or not at all suspected. There have been six cases of temporal and two of cerebellar abscess in which there was no clinical evidence of ear disease. Three of these died: at autopsy, in two there was golden fluid in the middle ear of that side only on which the abscess was situated, suggesting an old infection; and in one unmistakable evidence of bone disease on the same side as the abscess. Of the cases that lived one showed radiologically opaque mastoid air cells. The possibility of abscess should always be entertained in cases of suspected tumour if the history is short and if the cerebrospinal fluid gives any support, whether or not there is any evidence of a causative septic focus.

The significance of certain physical signs deserves greater emphasis. An abscess may not give rise to papilledema; in my experience papilledema has been absent in two out of three cases, and in cases of acute abscesses and in the early stages its absence is the rule rather than the exception. Neck rigidity and Kernig's sign are constant accompaniments of meningitis, but these signs must not be considered to indicate of necessity the presence of that condition. They are common findings in cases of cerebral tumour and their causation is related to brain herniation—through the hiatus tentorii and through the foramen magnum. An abscess causes similar dangerous herniations of the brain, so that nuchal pain and rigidity and Kernig's sign do not necessarily indicate meningitis; but those signs should always be viewed with gravity, and especially if associated with severe headache or drowsiness do they indicate the urgency of the situation.

During the last six years there have been under my care twenty-four cases of abscess secondary to ear or paranasal infection. Various methods of treatment have been tried and I have finally chosen the closed method which we owe to Clovis Vincent. In the following analysis are set out the results of the various procedures:

ANALYSIS OF TREATMENT OF 24 CASES OF BRAIN ABSCESS.

Cases		Treatme	nt		S	urvived	
9	Drained	***			000	2	
3 1 2	Drainage onl Aspiration + Decompression Aspiration +	drainage + drainag		drain	 nage	0 1 0 1	
15 3 4 2 5	Not drained Aspiration on Decompression Aspiration + Decompression	y + aspirati	on	nuclea	ition	10 2 1 (die 2 4	d later of epilepsy)

Various methods of draining an abscess have been employed and the results can be fairly described as disastrous, but the figures of survival for treatment by closed methods are much more favourable.

An analysis of the post-mortem findings is instructive, for it throws light upon the problems of treatment. Extensive and massive ædema of the brain was the most frequent finding, and pronounced brain herniation was noted in some of these cases. Diffuse leptomeningitis was the next commonest finding, and less often ventriculitis. Multiple abscesses were found in one case causing a honeycombing of the temporal lobe. In another case the abscess could not be detected by the needle. Pulmonary embolism caused the death of one patient. Another died in status epilepticus whilst temporarily discharged from hospital to await final enucleation of the abscess, which had been aspirated several times; the autopsy revealed a shrunken thick-walled abscess with no tecent spread of the infection. Thus it would appear that treatment usually failed on account of massive ædema with brain herniation or because of acute meningitis (including ventriculitis).

Of the actiology of brain ædema there is little knowledge, and indeed there is no unanimity of opinion as to the pathological criteria of its lesser degrees, nor of the precise mechanism of its development and spread. Its presence may be assumed if there is marked drowsiness, lack of improvement as a result of treatment (in the absence of meningitis), and the neurological signs of brain herniation. The treatment of ædema

in both abscess and tumour of the brain constitutes perhaps the most urgent and the most formidable problem in neuro-surgery. Dehydration methods have had and are still having a great vogue, but in my experience have proved disappointing. Indeed, I have been frequently impressed how in some cases cedema persists and spreads in spite of treatment, in a manner best described as fulminating and malignant.

By reason of the observations at autopsy of the displacements of the brain caused by ordema, and of the results of treatment, my opinion is hardening that the only hopeful line of attack is surgical decompression. This is by no means always successful, probably because it is not resorted to sufficiently early; and if advanced ordema is an irreversible change—this is almost certainly true. Such decompression for brain abscess is obtained by the Clovis Vincent procedure, and some measure of relief of tension results from the

mere aspiration of the abscess.

The avoidance of meningitis and the treatment of the established condition vie with brain cedema in difficulty and importance. Chemotherapy helps, but other methods must be employed at the same time. Diffuse meningitis may occur at the same time as the spread of infection into the brain, or it may be due to the surgeon's activities, During drainage, it is very liable to occur as a direct spread over the surface of the brain, and the two-stage method was introduced to cope with this. Infection may also spread centrifugally in the brain, probably as a result of the dislocation of the infected area towards the drainage opening in the skull and the consequent disruption of the delicate newly-formed natural barriers to micro-organisms. Operative, autopsy and experimental studies show that at the deepest pole of an abscess its wall is thinnest, and it is in this area that secondary loculi commonly form. From this poorly walled-off pole of an abscess, there is a most important pathway of infection to the subjacent ventricle, for ædema softens the intervening white matter and the ependyma of the underlying ventricle may rupture into this softened area. Ventriculitis has been quite clearly caused in this manner in two cases. Finally, as is well recognized, the ventricle tends to wander as a diverticulum through the softened white matter towards the brain fungus which tends to develop as a result of drainage, and the diverticulum can easily rupture on its The accepted treatment of acute suppurative meningitis uncomplicated by abscess is chemotherapy, maintenance of the patency of the cerebrospinal fluid channels by frequent lumbar puncture and the free administration of fluids-" forced drainage". an abscess is present, the subarachnoid spaces are inevitably obstructed by the swelling of the brain and by the herniation of brain into the various cisterns. Thus attempts to drain cerebrospinal fluid by lumbar puncture lose effectiveness, and, indeed, are dangerous by accentuating herniation and compression of the mid-brain or medulla. Some decompressive measure is, therefore, as logical a form of treatment for the meningitis as for the

Successful treatment depends upon accurate diagnosis; this must include precise localization, an estimate as to the "age" of the abscess, and the presence or otherwise of meningitis. So essential is such information that no ancillary method should be ignored. A diagnostic burr hole and tapping through a clean area of skin may be all that is necessary for confirmation in some cases; on the other hand, one should never hesitate to employ ventriculography. If ventriculography confirms the diagnosis—an osteoplastic flap is reflected forthwith and the abscess contents evacuated through a wide-bore blunt needle, the operation field being swamped with a bactericide such as proflavine, to avoid its infection. If tension is not sufficiently relieved, the dura mater may be opened so as to provide an orthodox osteoplastic subtemporal decompression and, provided no pus has been spilt, there is apparently little or no risk of infection. Even if the dura mater is not opened, bone should be removed from the base of the flap so as to provide a gradual decompression which results from the stretching of the dura mater. A burr hole is made in the bone flap over the most superficial part of the abscess through which it may be subsequently aspirated. When a diagnostic tap reveals an abscess conveniently accessible, and if there is but little swelling of the brain, decompression may not be needed, or may be postponed. In cases of cerebellar abscess, provided the patient's condition allows of it, the dura mater of the posterior fossa is fully exposed in every case; the abscess can be aspirated more easily than through a burr hole behind the mastoid process. But the dura mater should probably never be widely opened owing to the proximity of the cisterna magna, and the consequent ease with which diffuse meningitis can occur. The aspiration of a cerebellar abscess affords much greater relief of tension than aspiration of a hemisphere abscess, owing to its strategical position in causing an obstructive hydrocephalus.

At the time of aspiration, the cavity of the abscess is irrigated with electrolytic sodium hypochlorite (milton). Using small quantities (less than the amount of pus obtained), 50% milton is allowed very gently to flow into the cavity and is then aspirated; large quantities of ropy pus can usually be obtained, which would otherwise be too viscid to

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pass through the needle. When the fluid returns fairly clear, it is valuable to leave in the abscess a small quantity of 5% milton or of 1:1,000 buffered solution of proflavine. A bactericide in such a closed cavity appears to aid in the destruction of organisms (two abscesses have become sterile under treatment) and to accelerate the localization of infection and the maturation and contraction of the abscess wall. It is also a prophylactic against infection of the needle track. At first it may be necessary to repeat aspiration every few days, but these intervals gradually lengthen. The patient's condition, the amounts of pus obtained and the resistance of the abscess wall are all factors which are weighed in making a decision to re-aspirate.

Thorotrast (1-2 c.c.) injected into the abscess at one of the early aspirations is of great help. It gradually becomes "fixed" in the wall of the abscess and the size and the position of the abscess can be demonstrated radiologically. Thorotrast may fail to depict the whole of an abscess if there are several loculi. This happened in one case; over-confidence in the X-ray appearance led me to forget the possible presence of a deeper loculus, which was thus inadvertently ruptured during enucleation, and the patient died of a diffuse meningitis.

What criteria guide one as to when to enucleate the abscess? They are the subsidence of acute inflammation and the formation of a tough wall. This is indicated by the disappearance of toxamia and of meningitis, reduction of intracranial pressure—and consequent softening of the decompression—and diminution in the neurological signs of a focal cerebral lesion. The toughness of the abscess wall can be estimated by the blunt aspirating needle, and by the radiological appearance of the thorotrast shadow which diminishes in size and acquires a crisp crenated outline. There is a well-defined optimum period for successful enucleation. The above pathological criteria must be satisfied for obvious reasons, but if operation is unduly postponed, it becomes technically more difficult owing to the formation of an excessive degree of scarring around the abscess, leading to an unnecessarily wide excision of tissue. Secondary loculi or separate deeply placed abscesses may develop if a case is left too long. During the optimum period, the abscess wall is well defined, is sufficiently tough to "handle", and separates cleanly from the surrounding white matter. In this series, the age of the "youngest" abscess has been six weeks, and of the "oldest", six months, estimating age from the first symptom of intracranial disorder. The third month (i.e. between eight and twelve weeks) appears to be the "time of election" for enucleation.

Enucleation is facilitated by uncapping the wall of the abscess, excising with that portion of brain the adherent area of dura mater which constitutes the scarred track of the aspirating needle. When dissecting around the abscess, one must be ever alert for any prolongation of the abscess in a totally unexpected direction. The deeper the dissection the greater the care to be exercised to avoid rupturing its wall, and if the abscess is large and tense it is helpful to aspirate partially its contents, taking precautions against contaminating the field and the instruments, and the small hole must be closed by sutures. When the abscess is adherent to the wall of the ventricle, an opening into the latter may be unavoidable. In cerebellar abscess, the dissection is more difficult owing to the proximity of cranial nerves, and the abscess may be adherent to the dura mater covering the posterior surface of the petrous bone.

It is well recognized that epilepsy often follows the healing of an abscess, and enucleation may very likely avoid or diminish the frequency of this unfortunate sequel. But until the abscess has been finally eradicated an anticonvulsant should be given. In two cases fatal status epilepticus occurred after the patient left hospital; in one case the abscess had been drained, and had healed completely; the other has already been referred to. In neither case did an autopsy reveal any recent exacerbation of infection.

If the results of closed methods are examined again, it will be seen that they reflect the morbidity of the disease at its different stages. Some cases die in the early stages; extensive cedema was present at autopsy in the case which died following aspiration: the fatal issue might have been prevented by decompression, but there is no good reason to suppose that drainage would have been more successful. Of the three that died after aspiration and decompression, in one only was there extensive cedema. Only one case died out of eight in which enucleation was carried out, and this roughly indicates the relatively low risk of a fatal issue provided the early dangers can be safely overcome.

(That portion of the paper dealing with treatment is a summary of one delivered before the Society of British Neurological Surgeons, and is published fully in the Journal of Neurology and Psychiatry, 1942, 5, 1.)

Reference—McCONNELL, A. A. (1937), Brain, 60, 315.

Mr. Terence Cawthorne: An abscess of the brain is always secondary to a focus of infection elsewhere in the body, and the seat of this primary infection is to be found more frequently in the car than anywhere else.

That there may be a direct connexion, even a track, between the ear and the brain

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abscess which has arisen from it is often the case. But to look upon this track as a channel along which pus can flow either from the abscess to the ear or from the ear to the abscess is an oversimplification of the problem that may have led to the belief that in the presence of intracranial symptoms it is less unfavourable to find copious than scanty discharge from a diseased ear.

Nearly all otogenic brain abscesses are adjacent; that is to say the infection spreads upwards into the temporal lobe or less frequently backwards into the cerebellum, but from time to time cases are reported of abscesses in parts of the brain not directly in contact with the affected petrous bone. These distant abscesses have been found mainly in the frontal lobe and are the subject of a monograph by Nielsen and Courville who suggest that the infection spreads via the venous sinuses. Such abscesses may be difficult to localize as I found in the case of a woman with a history of a discharging left ear for many years who, following a chill, developed a severe headache and gradually became irritable and drowsy. Mastoidectomy revealed extensive disease with granulations on the lateral sinus. Exploration of the posterior fossa revealed no abscess either then or three days later, when in addition, the temporal lobe was also explored with negative results. Eventually, in the terminal stages, the opposite temporal lobe was explored and a large abscess found, but unfortunately too late to save the patient.

The neglected chronic suppurating ear is a much more frequent cause of brain abscess than the acute ear, and most authorities find that in 80% or more of abscesses there is a history of long-standing ear discharge. One reason for this lies in the fact that in the acute ear the prodromal symptoms caused by the infection eroding through the tegmen tympani are sufficient to demand exploration so that the process is arrested before a brain abscess can develop. On the other hand, in the chronic ear there may have been a very gradual erosion of the tegmen tympani, leaving the dura exposed to the disease with no symptoms other than a discharging ear and occasional bouts of headache. Such a state of affairs may be present for years, and may go unsuspected until an acute upper respiratory infection causes a flare up of the chronic process in the ear which spreads through the exposed dura to the brain.

I have noted erosion of the tegmen tympani by disease in nine cases of temporal lobe abscess secondary to chronic ear discharge, and in eight of these the increased thickness of the dura suggested that the erosion was of long standing; in all of them part at least of the exposed dura was sloughing. On opening the dura there was, in four cases, a subdural collection of pus with an underlying superficial ulceration of the brain tissue, but no deep abscess. In the remaining five, the abscess was separated from the surface by a narrow area of inflamed brain.

The invasion of the brain may be unsuspected because the otitis media is so fleeting, or again it may follow accidental damage during the course of a mastoid operation or as the result of exploring the brain for a supposed abscess.

Four methods of spread of infection from ear to brain may be recognized by the naked eye and are as follows:

- Spread to an adjacent or distant lobe with no obvious change in the overlying dura.
   Direct extension with obvious alterations in the appearance of the overlying dura.
   Direct extension with dural changes, subdural abscess and superficial cortical ulceration.
   Implantation abscess due to accidental or deliberate trauma.

In the first type it seems probable that the method of spread is by the perivascular spaces or by the blood-stream, either as an embolic or a thrombotic process, especially the latter, and in the distant abscesses it is more than likely that the extension has taken place via the venous sinuses. This is the most likely method of spread in the abscess that follows an acute ear infection, especially if the latter is fleeting.

The second type is, in my experience, the commonest and is most usually seen in abscesses secondary to chronic suppuration. In the cerebellar abscesses I have seen, the spread has been by this way, either via the bone between the sinus and the labyrinth cases), via the labyrinth (1 case), or via the lateral sinus (1 case).

The third type, where the abscess is on the surface of the brain in association with a subdural collection of pus, is possibly more common than is generally realized and is not distinguishable clinically from the other types of abscess. It deserves attention because it responds to local drainage without exploration of the brain. In fact exploration of the brain is likely to do more harm than good and I content myself with free incision of the dura and nothing more.

The fourth type is probably the least frequent and requires no explanation except that it serves as a warning against the casual exploration of the brain through an infected

In otogenic cases the classical features of brain abscess, namely headache, vomiting, stupor, slow pulse and subnormal temperature, are often modified by the acute infective process in the ear and adjoining intracranial space, and the only general symptoms that nnel

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I have found to be constant are headache and slow cerebration. I have not yet met a case in which headache was not a prominent feature.

Nominal aphasia is constantly present in abscesses of the temporal lobe on the left side. It has been said that in left-handed persons it might be expected to be present if the abscess were on the right side. The only right-sided temporal lobe abscesses that I have seen have been in right-handed persons and they did not have nominal aphasia.

I have, however, seen a left temporal lobe abscess in a patient who was left-handed and he had nominal aphasia.

I have, however, seen a left temporal lobe abscess in a patient who was left-handed and he had nominal aphasia. The case in question was a real problem because both ears had been discharging for years and both were acutely inflamed and there was nothing to choose between either of them as the cause of the meningitis and brain abscess from which the patient appeared to be suffering. Although semi-delirious and drowsy, he was sufficiently co-operative to exhibit well-marked nominal aphasia and as he was left-handed it was decided to explore the right ear first of all. Mastoidectomy revealed extensive disease in the tympanum and mastoid antrum but no erosion of the tegmen tympani and a healthy dura. Nothing more was done on the right side and the left mastoid was opened, when an eroded tegmen rympani was found with a sloughing dura, and a subdural and superficial cortical abscess were drained. It has been suggested that this patient, a young man of 23, was really right-handed and that his apparent left-handedness was due to initiating his elder brother.

The management of brain abscesses secondary to ear disease presents many problems, and a study of the literature reveals a wide variety of opinions as to who should treat them, how and when and by what route they should be drained and in what manner the drainage should be maintained; but on one aspect of the treatment opinion seems to be unanimous, namely that the abscess should be drained or evacuated in such a way as to avoid spread of the infection to healthy tissues in the cranium.

With this object in view, it is urged by many authorities that an abscess should be allowed to localize and become encapsulated before it is drained. This is probably true of many brain abscesses, but in those secondary to chronic otitis media, especially when, as is so frequently the case, there is an acute flare up of a chronic ear, I think that unless the condition of the patient forbids it, the mastoid should be drained without delay. This enables the infecting focus to be eradicated, and prevents further spread of infection from the ear to the intracranial space. It also allows for the inspection of the dura adjacent to the petromastoid and the evacuation of any extra- or sub-dural collection of pus. In the case of the subdural abscess that may be accompanied by superficial cortical ulceration or at any rate some degree of encephalitis, this drainage of the infecting focus is usually sufficient to arrest the process. A policy of waiting in this type of case is a mistake. The only way of knowing that such a state of affairs is present is by exposing the dura at the site of infection.

When an abscess within the brain appears ready for evacuation, the question arises as to the route by which it should be drained. As the principal object is to drain an abscess without encouraging the spread of infection, advantage should be taken of any pre-existing track along which the abscess may be drained. Besides being shut off from the remainder of the intracranial space it has the additional advantage, in the case of adjacent abscesses, of being the shortest distance between the abscess and the surface.

When an abscess is thought to be adjacent to an infecting ear, the first step should be a thorough exposure of the dura adjoining the ear by means of a radical mastoid operation. An extradural or subdural abscess can be drained and if there is evidence of a track leading either to the middle or to the posterior fossa, the abscess can be drained along this track. If not, and the only way of being certain of this is to expose the dura via the mastoid, it may be wiser to explore the brain through a separate, surgically clean, approach.

The President said that the mastoid should always be opened and thoroughly explored and the dura uncovered. After that he would wait for the abscess to localize.

Had any member used the method of drainage through the track (Lemaître's method)—the introduction of a fine catheter with gradual dilatation along the track?

Was there such a thing as a non-suppurative encephalitis, or, alternatively, did every brain abscess start with a non-suppurative encephalitis?

Lastly, there was the importance of headache. No patient with an uncomplicated mastoid, however much pain he might have, should have a headache.

Mr. Cawthorne had asked about distant abscesses. He had seen one in the opposite temporal lobe and this he had discovered too late.

Mr. W. O. Lodge said that if they were to wait until their patients came before them with meningitis they were bound to have a very high mortality, and of the few patients who recovered a certain number would suffer later from epilepsy. Therefore a more aggressive attitude should be cultivated. The commonest cause of brain abscess was chronic otitis media. In 1941 2% of candidates for the Services were rejected on account of chronic otitis media, which should therefore be made a notifiable disease.

Mr. Thacker Neville was surprised at Mr. Northfield's insistence on excision of the abscess cavity. He would puncture the abscess with a needle and put in two minute drainage tubes and aspirate through them. Mr. Northfield had not converted him to excision by his figures.

Mr. R. G. Macbeth said that the best results were obtained in cases of brain abscess by a neuro-surgical team. It was important to differentiate between the chronic and the acute type of brain abscess. Though otologists had obtained their successes in the chronic type most of them had been disappointed with their results in the acute type. If neuro-surgeons handled the acute cases, there was at least a hope that some of these would recover. Where there was acute middle-ear suppuration, this should be dealt with first.

Mr. Holt Diggle said that neuro-surgery had revolutionized the treatment of brain abscess in general. But he still thought that so far as their own specialty was concerned—and they were dealing more largely with otitic brain abscess than with abscesses of the frontal lobe—they would as a group prefer to continue the old teaching of Macewen to drain the brain abscess through its stalk of infection.

Mr. Cawthorne had said that in all cases of chronic infection a radical mastoid should be performed, but when one had to deal with an acute hæmorrhagic condition it was difficult to do a good radical mastoid and the patient might be in a moribund condition when seen. Of late it had been his practice to do a Schwartz operation in such cases and deal with the intracranial condition as revealed. Since then he had had better results. Subsequently he had dealt with the chronic condition by performing the radical operation after the acute symptoms had subsided.

Mr. I. G. Robin said, with reference to aphasia, he was reminded of a patient who went into an L.C.C. hospital two years ago in coma. She had had an otitis media for five years. She had hemiplegia and true aphasia, which cleared up, and he saw her one and a half years later with hemiplegia again and no aphasia. The patient was right-handed, and this was a left-sided abscess, 3 in. inwards and forwards with multiple loculi. It had a very dense capsule, with the track leading forward. Injection showed several cerebral loculi far forward. He could feel no abscess wall to these loculi, and he thought there must have been an acute spread within the last month.

The President, in closing the discussion, said that in the absence of a neuro-surgeon he was perfectly willing to do decompressions to any size and if need be drain the abscess, but if it came to a question of enucleating the abscess, that was entirely a neuro-surgeon's job, and fortunately even in wartime a neuro-surgeon was usually available.

Mr. D. W. C. Northfield (in reply) said that with regard to the treatment given to the ear, he had always been able to work with an ear surgeon. Some cases that had come to him from other hospitals had already had the ear disease attacked in one way or another, and there had been no necessity to do anything further. In cases in which abscess had arisen as the result of chronic ear disease, when he had successfully dealt with the abscess, he referred the case to an aural surgeon, or, if the ear condition had appeared to be rather more urgent, he dealt first with what appeared to be the predominant condition. It was wrong to operate on the ear in a patient who might be moribund not because of the ear disease, but because of the abscess. Then the treatment of the abscess should take precedence over anything else. After one or two aspirations, which was now almost his routine method, if the patient was improved, and if then a stage was reached in which the ear condition was predominant he would say: "Get on with the ear operation and do whatever is necessary." Each case must be taken on its own merits.

Left-handedness or right-handedness would appear to depend on which of the two hemispheres was the dominant one—usually it was the left. A left-handed person usually had a dominant right hemisphere. On the other hand, he might be fundamentally still dominant in his left hemisphere but have developed left-handedness. In such a case he would expect the left-handed person to have aphasia only from the left temporal region. Usually a left-handed person had aphasia only from the right-sided lesion, although he had seen such an unusual case as a right-handed person having aphasia from a right-sided lesion. Such a person was dominant in his right hemisphere, but he grew up using the right hand.

Headache was a conspicuous feature of brain abscess.

As to the necessity of enucleating an abscess he had had three cases in which aspiration only was undertaken and appeared successful, but he felt nervous lest these cases should flare up again; in one of these a ventriculogram was done and another was watched carefully, but no sign of returning abscess was discovered; but he always felt happier when the abscess was removed as if it were left there was always a risk that loculi would form.

As to aspiration and drainage by a fine tube, this might be all right in given cases. Each surgeon should proceed with those methods which in his hands had proved most successful. In his own hands drainage had not been successful.

Hammering in a case of brain abscess must accentuate the condition. It was a point which Mr. Hugh Cairns had raised at a meeting of the Section some years ago, and he quoted Macewen who said that he never used a hammer but always a curette or burr.

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# Sections of Otology and Laryngology

COMBINED MEETING HELD AT OXFORD

[July 17, 1942]

### OTOLOGICAL SESSION

Chairman-F. W. WATKYN-THOMAS, F.R.C.S.

(President of the Section of Otology)

## The Effect of Certain Cerebral Lesions Upon the Caloric Responses 1

By GERALD FITZGERALD and C. S. HALLPIKE

(From the Research Unit, National Hospital, Queen Square, London)

ACCORDING to Bauer and Leidler (1911) the removal of one cerebral hemisphere in the rabbit results in the exaggeration of the nystagmic response to a cessation of rotation towards the opposite side. For example, removal of the left hemisphere causes an exaggeration of the nystagmic response to a cessation of rotation to the right.

According to Ewald's law, the horizontal canals which are chiefly involved respond preponderantly to ampullo-petal flow of endolymph. Now cessation of rotation to the right causes an ampullo-petal flow of endolymph in the left horizontal canal, and Bauer and Leidler, accepting Ewald's law, argued that the enhancement of the nystagmic response to this stimulus was due to an increased sensitivity of the left labyrinth; and from this were led to the general conclusion that ablation of a cerebral hemisphere gives

rise to an increase in sensitivity of the homolateral labyrinth.

These observations were repeated in 1923 by Dusser de Barenne and de Kleyn. Following removal of one hemisphere (e.g. the left) there was observed as before an exaggeration of the nystagmic response to cessation of rotation to the right, so confirming the finding The effect was then tried of caloric stimulation. of Bauer and Leidler. caloric stimulation there was found an exaggeration of the response from the left labyrinth, a result which seemed to confirm Bauer and Leidler's notion of an increased sensitivity of the labyrinth on the side of the missing cerebral hemisphere. This was surprisingly contradicted, however, by the results obtained with cold water, which revealed an exaggeration in the response of the right labyrinth. These findings were explained in the following way: The three stimuli of which the effect was observed to be enhanced were (1) Cessation of rotation to the right. (2) Hot caloric stimulation of the left labyrinth. (3) Cold caloric stimulation of the right labyrinth. All of these have it in common that they give rise to nystagmus to the left, and Dusser de Barenne and de Kleyn therefore concluded that the effect of removing one cerebral hemisphere, in this case the left, was a central facilitation of all and any labyrinthine impulses which would normally result in nystagmus to the same side. According to the terminology then adopted, the phenomenon was described as "nystagmusbereitschaft" to the side of the ablated cerebral hemisphere. These findings had an obvious application to the clinical problem of localization of cerebral lesions in man and were so applied by de Kleyn and Versteegh, who reported Hot and cold caloric tests were carried out according to the threshold method of Kobrak (1918) in 36 subjects with cerebral lesions and a "nystagmusbereitschaft" was found in 11. No information was, however, given as to the nature or position of the lesions shown by clinical examination, operative or post-mortem findings except in one instance in which a large abscess of the frontal lobe was correlated with a "nystagmusbereitschaft" to the same side.

In the present work further evidence has been obtained of the occurrence in the human subject of "nystagmusbereitschaft" attributable to cerebral lesions, and it has further been possible to identify the area of the cortex, disease of which determines the appearance of this phenomenon. As an English translation of "nystagmusbereitschaft", the term directional preponderance of induced vestibular nystagmus has been devised and will be adhered to. It has the particular advantage of describing the essentially directional

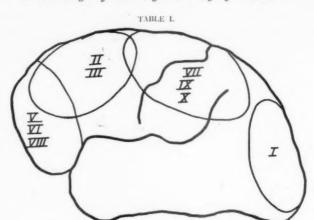
character of the disturbance.

#### MATERIAL

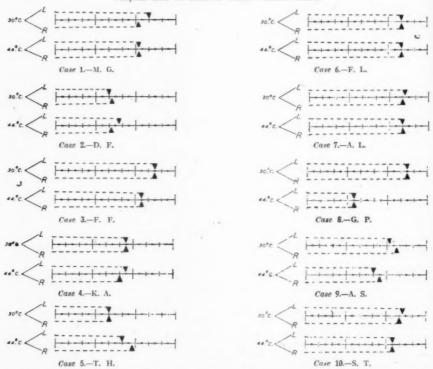
This was provided from the wards of the National Hospital and consisted in all of some 50 subjects in whom there was clinical and often other evidence of supratentorial

<sup>&</sup>lt;sup>1</sup> Abridged version. For a full account of this work see *Brain*, 1942, **65**, 115. Studies in Human Vestibular Function: I. Observations on the Directional Preponderance ("Nystagmusbereitschaft") of Caloric Nystagmus Resulting from Cerebral Lesions. The figures are reproduced by permission of the Editor of *Brain*.

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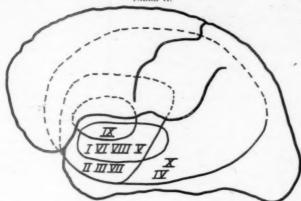


Temporal lobes not involved. Caloric reactions normal.



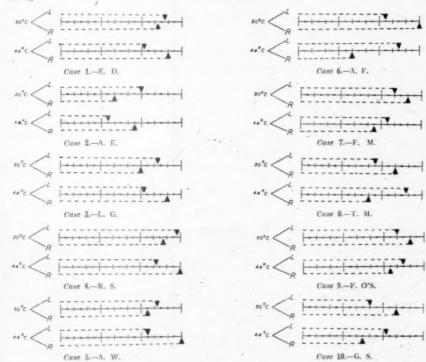
lesions of the central nervous system. In none of these was there any evidence of aural disease or any spontaneous nystagmus. Hearing was normal in all. Hot and cold caloric tests were carried out with certain modifications of the usual procedure. In some cases the responses revealed directional preponderance, in others it was absent, and it soon became apparent that its occurrence was dependent upon the localization of the lesion. Final conclusions were based upon 20 subjects in whom the existence and localization of the lesions could be considered as securely established by the clinical, operative or post-mortem findings. For the most part the lesions were actively growing tumours, but some long-standing vascular lesions were also included.





Cases 1-5.—Lesions involve right temporal lobe. Directional preponderance of caloric nystagmus to the right.

Cases 6-10.—Lesions involve left temporal lobe. Directional preponderance of caloric nystagmus to the left.



METHODS

To obtain maximum efficiency of the caloric tests certain technical modifications were found necessary. For the details and rationale of these modifications reference should be made to *Brain*, 1942, Part 2, p. 115, wherein are also discussed the limits of variation in the results obtained in normal subjects. The form adopted for expressing the results is shown in fig. 1, which gives the average result obtained in normal individuals. Each continuous line represents a 3-minute period, subdivided into intervals of minutes, 20 seconds and 10 seconds. L. and R. denote the reactions of the left and right labyrinths at 30° C.

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and 44° C. The stimulus extends in all four over the first 40 seconds and the dotted lines indicate the duration of the responses. For reasons given elsewhere this is measured from the application of the stimulus.



Fig. 2 shows the response pattern characteristic of directional preponderance to the right (the effect obtained by Bauer and Leidler in the rabbit by removal of the right cerebral hemisphere). There is an exaggeration of the left cold and right hot responses, both of which consist of nystagmus to the right. The right cold and left hot responses, both of which consist of nystagmus to the left, are diminished.

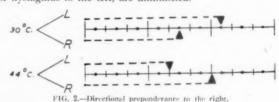


Fig. 3 shows the response pattern characteristic of directional preponderance to the left (the effect obtained by Bauer and Leidler in the rabbit by removal of the left cerebral hemisphere). There is an exaggeration of the right cold and left hot responses, both of which consist of nystagmus to the left. The left cold and right hot responses, both of which consist of nystagmus to the right, are diminished.



### RESULTS

Table I shows the localization of the lesions and the caloric responses in 10 cases in which the responses were normal In some of these the lesions involved the left hemisphere and in some the right. For the purpose of illustration they are all shown as being projected upon the lateral surface of the left hemisphere. The lesions are scattered throughout the hemisphere from the frontal to the occipital poles, with the exception of the temporal lobe. The caloric responses vary in their general magnitude but there is no alteration of their normal pattern.

Table II shows the localization of the lesions and the caloric responses in 10 cases in which the latter showed directional preponderance. In Cases 1—5 the lesions involved the right temporal lobe with directional preponderance of the caloric responses to the right. In Cases 6—10 the lesions involved the left temporal lobe with directional preponderance of the caloric responses to the left.

#### CONCLUSIONS

- (1) The findings of Dusser de Barenne and de Kleyn are confirmed that directional preponderance of induced vestibular nystagmus (caloric) does occur in association with some lesions of the human cerebrum.
- (2) The matter has been carried a stage further by the identification of the temporal lobe as the site of the nervous mechanism the involvement of which determines the occurrence of this phenomenon.

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[July 17, 18, 1942]

### LARYNGOLOGICAL SESSION

Chairman-E. D. D. Davis, F.R.C.S.

(President of the Section of Laryngology)

# DISCUSSION ON INJURIES OF THE FRONTAL AND ETHMOIDAL SINUSES

Major C. A. Calvert, R.A.M.C.: The frontal and ethmoidal air sinuses insinuate themselves so intimately into the bony framework of the skull that, under the stress of injury and disease, they can be at times a very real anxiety to the neurologist and neuro-surgeon. The bony partition between the mucosal lining of the sinuses and the dural covering of the brain is very thin and brittle, particularly over the ethmoidal cells, and it is easily disrupted when severe grades of violence, such as those incidental to motor vehicle and aircraft accident, impinge on the frontal and fronto-temporal regions or, less frequently, on the face which juts downward prominently from the anterior part of the base of the skull.

The material on which my study of the problem of fractures of the frontal and ethmoidal sinuses is based has been obtained mostly from a military hospital for head injuries, all the cases treated there being included, and also from Brigadier Cairns' own series of pre-war cases.

The total number of cases in the series is 128. Of these, 103 were treated at the Military Hospital and 25 were pre-war cases of Brigadier Cairns. In trying to arrive at an idea of the incidence of frontal and ethmoidal sinus fractures in cases of head injury in general, I shall confine myself to the series in the Military Hospital. Out of a total of 1,731 cases of head injury admitted since the hospital opened, 655 or 37% had fractures of the vault or base of the skull. Out of these 655, 103 or 15% had fractures involving the sinuses now under discussion. This is a higher percentage than in a comparable General Hospital because more members of His Majesty's Forces travel rapidly on motor-cycles or in motor-cars or aeroplanes than do civilians. Reference to Table I, in which the nature of the accident is tabulated in percentages for the hospital series of 103 cases, shows that in 69% the patient had been travelling at speed at the time of his head injury, whilst in only 9% was the injury due to his being knocked down when walking along the road. This differs greatly from conditions in civilian life in which the latter cause is much more frequent.

### TABLE I.-NATURE OF ACCIDENT.

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Motor-cycle crash	***	***		***		44
Motor-car collision	***	***	***	***	***	19 69%
Aeroplane crash						6)
Bomb, shell, or gunsho	t wound	***				8
Knocked down by mote	OF-CRF					9

In 70% the fractures were compound not only into the nose, but also through the skin of the forehead. Thus, an open wound demanding prompt excision frequently exists, and the important question arises how much should be done at operation in the acute stage for the fracture underneath. This will be referred to later.

Anosmia.—The state of the olfactory sense was known in nearly all of the cases. In 35% of these, the sense of smell was completely lost in one or both nostrils. Provided the nasal passages are clear, the presence of complete anosmia either unilaterally or bilaterally has a certain implication, for dural tearing was more than twice as common in such cases as in patients with only slight or no impairment of smell whatever.

Apart from gross brain damage, which is no more inimical in the frontal lobes than elsewhere in the brain, the chief hazard in cases of frontal or ethmoidal sinus fracture is laceration of the dural barrier and spread of infection intracranially from the nose. The question whether or not the dura is torn is therefore of the utmost concern. The knowledge that it is torn at once gives the case a more sombre complexion. The two unequivocal signs of dural rupture are leakage of cerebrospinal fluid from the nose and the presence of an intracranial aerocele. With either of these complications, the patient

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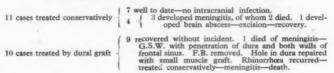
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must be considered to be in grave jeopardy. An analysis of the cases in the present series

will sufficiently demonstrate this point. Cerebrospinal rhinorrhæa.—Of the total of 128 cases, there were 21 with cerebrospinal rhinorrhoea, of whom 11 were treated conservatively and 10 were submitted to operation. In most of the conservatively treated cases, operation was advised but rejected by the patient. In a few, operation was for one or another reason not undertaken, either because of the patient's advanced age or other disadvantageous circumstance, or because the cerebrospinal fluid leak, of very short duration and never profuse, had long ago ceased by the time the patient presented for treatment, and, judging by the X-ray appearance of the fracture, it was likely that the meningeal tear had been firmly sealed off. The results in this series are summarized in Table II.

### TABLE II.—CASES OF CEREBROSPINAL RHINORRHŒA.



Intracranial aerocele.—This condition was present in 9 of our cases. Six of them were treated conservatively and 3 by repair of the dura. All of the 3 cases operated upon recovered. Of the 6 patients treated conservatively 4 recovered and are well up to date. The remaining two developed meningitis and one of them died (see Table III).

#### TABLE III.-CASES OF INTRACRANIAL AEROCELE.

6 treated conservatively		 4 recovered without incident. 2 developed meningitis,
3 treated by dural graft	***	 of whom 1 died. All recovered without incident.

In a further 13 cases in which there was neither a history of rhinorrhoea nor radiological evidence of aerocele, the presence of a dural laceration was either demonstrated at operation or proved to have been present in certain cases that succumbed as a result of meningitis or brain abscess.

Cases with positive evidence of dural tear.—Adding the later 13 cases to the previous groups gives a total of 43 cases with positive evidence of a dural tear complicating frontal and ethmoidal sinus fractures. A study of the combined group is instructive.

Twenty of these cases were treated conservatively, and of these, 9 recovered without incident and 11 developed either meningitis or brain abscess, of whom 6 died.

Twenty-three had a dural repair operation, and of these 20 recovered without incident and 3 died. The 3 cases terminating fatally were all operated on during the acute stage.

One patient was subjected to excision of the scalp wound over the fractured frontal sinus within twelve hours of the accident, the fracture itself being left untouched. He had a stiff neck and a positive Kernig sign after operation, and two days later he developed a temperature of 103° F. The onset of meningitis was suspected and therefore the anterior and posterior walls of both frontal sinuses were removed and a large dural laceration at the back of the frontal sinuses repaired by a fascial graft. Unfortunately the patient developed a severe bronchopneumonia which terminated fatally. Post mortem the dural repair was entirely satisfactory. There was a thin layer of subdural clot and evidence of cerebral fat embolism, but none of meningitis. The reaction produced by clot and cerebral fat embolism had been mistaken for incipient meningitis, and had an extensive operation for dural repair not been undertaken then, but rather deferred until the patient's condition was less critical, it is possible that he might have survived.

The second death in the operated series was that of a patient who had received a gunshot wound in the centre of the forehead eight hours before admission to hospital. There was no amnesia. He was quite conscious and rational. The situation of the foreign body was localized carefully by X-rays and was found to be almost exactly in the mid-line about the position of the genu of the corpus callosum. One hour after admission to hospital, the entrance wound in the centre of the forehead was excised, exposing small, punched-out defects in the anterior and posterior walls of the frontal sinus. The macerated brain tissue presenting through the ren in the dura at the opening in the posterior wall of the frontal sinus was removed by gentle suction, and the metallic foreign body extracted with a pair of sinus forceps without difficulty. The operation was completed by the application of a small muscle graft over the dural opening, and the wound was closed. The patient did well afterwards, apart from a s

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In order to estimate the incidence of spread of infection intracranially and the deathrate following fractures of the skull involving the frontal and ethmoidal sinuses, I shall have to limit myself to the hospital series. Out of the total of 103 cases, there were 5 deaths from meningitis or brain abscess. Two further cases developed a brain abscess secondary to the sinus fracture, but recovered with excision, and one case of meningitis survived after intensive M & B therapy and was then successfully grafted. This represents a morbidity rate of 8% and a death-rate of 5% from spread of infection intracranially in the frontal and ethmoidal sinus fractures in our series. For several reasons these figures probably do not give a true representation of the outlook in cases of fracture involving the paranasal sinuses. First, a number of our cases with dural laceration, and certainly most of the severe ones, were protected by a fascial graft. Secondly, as the hospital has been in operation for only about two and a half years, the follow-up period is very short, and it would be too optimistic to expect that all the cases with positive evidence of dural tearing, untreated by fascial grafting, would escape a fatal meningitis in the future. Thirdly, it is probable that some of the cases with severe dural tears actually develop meningitis and succumb without having recovered sufficiently from their cerebral damage to be fit for transfer to a head injury centre. In many cases of frontal sinus fracture, for example those in which it can be shown radiologically that the fracture is limited to the anterior wall of the frontal sinus, the question of dural repair does not arise, and a number of cases fall into this group.

In the cases of cerebrospinal rhinorrhoea and aerocele (operated and unoperated cases inclusive) the morbidity rate in respect of intracranial infection was 23% and the death-rate 12%. In the cases of cerebrospinal rhinorrhoea and aerocele treated conservatively, the morbidity rate due to intracranial infection was 50%, and the death-rate 25%. Judging from these figures it seems that, unless there are very definite contra-indications on general grounds, all cases with a history of cerebrospinal rhinorrhoea or an intracranial aerocele should be operated upon and have their dural injury repaired.

Some surgeons, however, consider that dural repair is unnecessary in those cases of cerebrospinal rhinorrhœa in which the leakage has been slight and has ceased within a few days of the accident. Our figures show that this course is accompanied by some risk, and we have records of patients who have developed brain abscess or meningitis several months after the subsidence of a slight and evanescent cerebrospinal rhinorrhœa. It is generally granted that the presence of an intracranial aerocele indicates the necessity for dural repair.

Including Brigadier Cairns' cases, intracranial infection occurred in 6 patients in the series in which no history of rhinorrhea was forthcoming, and in which the presence of an aeroccle had been excluded by X-ray. In other words, intracranial infection occurred in 6 cases in which there was no clinical evidence of dural laceration. Two of these patients developed brain abscess; one died, and the other recovered after excision of the abscess. Of the remaining 4 who developed meningitis 3 died. The fourth patient recovered with intensive sulphanilamide therapy. He subsequently had a fascial graft operation carried out successfully for repair of a hole in the dura over the posterior ethmoidal cells.

The question therefore arises whether there are any other indications, apart from rhinorrhoea and aerocele, which point to the likelihood of laceration of the dura in relationship to the fractured cranial wall of the frontal and ethmoidal sinuses and thus indicate the advisability of operative intervention. The most important investigation in this respect is the radiological one, and I would like to acknowledge my indebtedness to Major Davies for his help in the difficult radiological aspect of the problem. The views that have been found most useful, apart from the lateral and stereoscopic P.A. films, are an occipito-mental projection and oblique orbital views taken from either side to show the optic foramina, orbital roofs, and the region of the crista galli and ethmoidal cells.

A wide gap in the posterior wall of a frontal sinus or any considerable displacement of bone in that situation, a fracture running down in the posterior wall of the frontal sinus to the anterior ethmoidal cells and widening rapidly as it descends, a fracture passing from one anterior cranial fossa across the cribriform plate to the opposite side of the base of the skull, a fracture associated with the projection intracranially of a sharp fragment from the back of the frontal sinuses or the medial part of the orbital roof, which would be likely to penetrate the dura, would all have to be regarded as likely to be complicated by dural laceration and therefore probably best treated by operation. The same applies to the inverted U-shaped fracture resulting from a blow on the side of the head in the region of the base of the external angular process of the frontal bone. The posterior limb of this fracture passes down into the anterior temporal region, whilst the anterior

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limb descends across the forehead to enter the frontal sinus on the same or opposite side, ending in the roof of the orbit. This is a dangerous type of fracture, especially when associated with much displacement at the fronto-zygomatic synostosis or with tilting of the crista galli over to the side. Either of these displacements suggests the likelihood of distortion in the neighbourhood of the ethmoidal cells with fracture of their thin brittle roof. Any one of these fractures, especially if accompanied by gross impairment of smell, would be regarded as a strong indication for operation, apart altogether from the presence of rhinorrhoa or intracranial aerocele.

Operation.—The majority of cases have wounds in the scalp leading down to the line of fracture. Excision of this wound, as in cases of compound fracture elsewhere, is therefore essential as soon as shock has been controlled. If there is cerebrospinal fluid coming from the nose, or if there is cerebrospinal fluid or brain tissue escaping from the forehead wound or the fracture is such that it is likely that there is an underlying dural tear, it has to be decided whether or not a long operation is to be undertaken to repair the dura during the acute stage. If the patient's general condition is good, the wound relatively clean, and little or no evidence of brain damage, and if adequate X-ray studies can be made to show the ramifications of the fracture without detriment to the patient's general condition, and all the requisite neuro-surgical facilities are available, the best course may well be to proceed at once, turn an osteoplastic flap if necessary, and repair the dural defect. In many cases some or perhaps all the attendant circumstances are disadvantageous: the wound is grossly contaminated, the general condition is such that to turn the patient about in an endeavour to obtain satisfactory X-ray films would prejudice his chances of survival, or he is perhaps so rebellious and unco-operative that nothing short of general anæsthesia will suffice to control him during operation. In the majority of these, I believe the best course in the first instance is merely to excise the scalp wound thoroughly, having first obtained portable X-ray views so as to have some idea of the condition of the skull underneath. Even this limited interference should be deferred until the patient has recovered from shock, the scalp in the meantime having been shaved, the skin cleansed up to the edge of the wound, and a sterile pad sprinkled with sulphanilamide applied. The operation should when possible be carried out under local anæsthesia. The skin edges having been excised, all foreign bodies, blood-clot, fragments of devitalized tissue, and any small loose fragments of bone are removed, and the operation should be terminated by dusting the wound with sulphanilamide and suturing it carefully in two layers with interrupted sutures of waxed silk, and without drainage. It is wrong to prise up and pull out in haphazard fashion large depressed portions of bone through an inadequate incision and then to retire, leaving unrepaired a dural tear now in more easy communication with the nose or the air sinuses than it was prior to the bone removal. Subsequently, the patient is given adequate doses of one of the sulphonamide drugs. I think chemotherapy is of value and should be employed in every case with blood-clot in the sinuses. No attempt should be made to wash clots out of the nose. If the patient is unconscious, he is kept well over on his side to facilitate the escape of blood and secretions from the air passages. As soon as he is sufficiently recovered to co-operate, he is warned of the risk of blowing his nose or sneezing. Then, when the immediate dangers incidental to his brain injury are past, a thorough X-ray study of the fracture should be undertaken. Now I believe is the time when, with all the data relating to the patient well worked out and with the probable situation of his dural lesion in mind, operation for the repair of the defect should be undertaken, the approach most likely to give an adequate exposure of the hole in the membrane being selected. In all cases with cerebrospinal rhinorrhoea, it is important that the patient should be nursed in a separate room, that his attendants should wear a mask, and that no one suffering from a head cold should be allowed to visit him.

In cases with gross comminution and depression of both walls of the frontal sinuses and almost certain dural laceration directly underneath the fracture a complete removal of the anterior wall, the posterior wall, and the mucosal lining of both frontal sinuses may be necessary during the acute stage. Then the dura is repaired and the wound is closed with a drain passing through the fronto-nasal duct into the nose, as recommended by Cone. The skin of the forehead subsequently becomes adherent to the underlying dura and the exenterated sinuses are thus permanently obliterated. The supra-orbital margins should be spared as far as possible during bone removal, but, notwithstanding this, the operation is a very disfiguring one; and though the cosmetic appearance can be improved by bone-grafting later, the deformity may have some psychological effect on the patient.

Teachenor recommended operation in every case of frontal sinus fracture during the

acute stage, whether there was leakage of cerebrospinal fluid or not. He made a small incision at the upper medial angle of the orbit and removed that part of the orbital roof forming the floor of the frontal sinus. Blood-clot was then sucked out, but, unless rhinorrhea existed or ccrebrospinal fluid was found in the sinus, nothing further was done except to leave a drain of rubber tubing, the inner end of which was made to lie accurately over the upper end of the fronto-nasal duct, so that air forced up through the latter from the nose would have a ready means of escape to the exterior. This drain was left in place for a week. When there was a complicating rhinorrhea, the anterior wall of the frontal sinus was sacrificed to an extent sufficient to give good exposure of its posterior wall, which was in turn ablated to permit of repair of the underlying dural tear. There are certain objections to Teachenor's method. In the first place, operation on the injured sinus is unnecessary in the majority of uncomplicated frontal sinus fractures, for the blood-clot within is rarely the starting point of a sinusitis, especially if sulphanilamide therapy is employed, injunctions against blowing the nose are followed, and interference with the nostrils in order to get rid of blood-clot is avoided. In the second place, the exposure obtained by the bone removal he recommends is inadequate, should the dural tear lie well back in the cribriform plate region, which is not infrequently the case. Lastly, drainage of the sinus to the exterior sometimes results in a troublesome fistula.

Unless there is gross comminution and depression of both walls of the frontal sinuses, however, in which case Cone's operation may be employed, the most satisfactory method of approach when operation appears indicated, even during the acute stage, is by reflection of a small frontal osteoplastic flap just above the level of the frontal sinuses, as is usually

employed in cases of chronic cranio-sinus fistula.

A history of preceding chronic frontal or ethmoidal sinusitis in a patient with traumatic cerebrospinal rhinorrhoea should be regarded as an indication for immediate repair of

the dural defect.

The usual course, when operation is carried out during the chronic stage, is to turn a small frontal osteoplastic flap, which should be made to extend across the middle line when the fracture involves the posterior wall of both frontal sinuses or spreads back in the roof of the orbit on either side. The site of the dural tear may then be approached extradurally or intradurally. The method which Brigadier Cairns has used (J. Laryng, & Otol., 1937, 5.2, 589) and which has been employed at our military hospital is the extradural approach. The dura is first separated from the posterior wall of the frontal sinus and then backwards along the roof of the orbit until the tear is reached. A fringe of dura sufficiently wide to permit of water-tight suture or the secure application of a fascial graft, must be exposed all around the tear in the membrane.

The intradural approach recommended by Julian Taylor for the treatment of a chronic fistula and reported by Major Eden in the *British Journal of Surgery* (1942, 29, 299) may also be employed. It is claimed that thereby (1) a more ready localization of the dural defect and an easier repair of it with fascia is possible than by the extradural method; (2) that, if the necessity should arise, closure of a rent on the other side of the middle line can be readily effected; and (3) that direct contact with the fracture line leading

into the sinus, which may possibly be infected, is avoided.

The final complication of these sinus fractures to which I will refer, and that only very briefly, is sinusitis. In the hospital series there have been only 3 proven cases of frontal sinusitis, and intracranial infection did not occur in any of them. In all, the infection was very mild: one case responded within a few days to sulphanilamide therapy and inhalations; another to an intranasal operation; and a third to drainage of a small abscess which appeared at the upper inner angle of the orbit.

These fractures of the air sinuses are of more serious moment and more often productive of grave complications than the literature on the subject would lead one to expect.

Brigadier H. Cairns: At the outbreak of war our view was that practically all fractures into the frontal and ethmoidal sinuses should be operated on. We believed that there was usually a dural tear and, consequently, a considerable risk in every case that meningitis would occur as an immediate or remote complication. When the dura is broken there is usually considerable separation of the edges and these unite by a layer of fibrous tissue which is thinner than the dura itself; this scar has proved in a number of cases inadequate to prevent the spread of infection from the accessory sinuses to the meninges. In a series of cases reported to this Section five years ago (Cairns, 1937) there were some in which fatal meningitis ensued two or more years—in one case six years—after the original injury. Our belief was—and so far I know of no evidence against it—that thorough repair of the dura by suture or by fascia lata provides an adequate barrier against infection.

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After the outbreak of war, with the establishment of the Military Hospital for Head Injuries, we soon found that fractures into the accessory sinuses were much more common than we had supposed. I do not think that this means that the frequency of these injuries has increased in war time, for as Major Calvert has shown nearly half of them are due to motor-cyclists' injuries, and the number of these is no greater now than it was before the war. It is merely that now, for the first time, we have the patients segregated, and also they are probably much more thoroughly examined by X-rays than they were before, It is on X-ray examination that the diagnosis depends. Our pre-war ideas about treatment had been based on the selected cases of rhinorrhoea and aerocele. Many of the military cases prove to be simple fissures of the anterior or posterior walls of the frontal sinus; there is no rhinorrhoa or aerocele, and it may be extremely difficult to infer from X-ray examination whether the dura is torn and separated, or whether it is intact. In one case where X-ray showed a fracture with some separation of its edges in the posterior wall of the frontal sinus I found at operation that the dura was caught in the fracture line, but was intact. Either it had never been torn or, if torn, its edges had not separated and had united firmly.

I think there is general agreement that the dura should be repaired in cases of rhinorrhoa and aerocele, and in any other case in which an attack of meningitis has occurred after sinus injury, with recovery. The main problem is to know what to do about the other cases in which X-ray shows injury to the sinus walls. What is the risk of meningitis, either immediate or remote, in such cases, treated conservatively? This question can only be answered by a systematic long-term follow-up of an unselected series of cases. As Major Calvert's studies show there is a risk of meningitis in such cases, but whether it is small or large we do not know. Meanwhile more information can be obtained by X-ray studies and by correlating the X-ray findings with the condition of the dura as seen at operation and necropsy. It may be that certain radiographic signs, such as tilting of the crista galli, will prove to be fairly constantly accompanied by tearing of the dura; and that, with certain radiographic appearances, the presence or absence of anosmia will have a certain significance in relation to the state of the dura.

I have been struck with the low incidence of sinusitis after fracture into the sinuses. In Major Calvert's series of about 100 cases there were only three in which there was clinical evidence of frontal sinusitis in the weeks following the injury. This differs from what happens in the mastoid process: in my experience, when a fracture involves the mastoid, mastoiditis often occurs.

The infrequency of overt sinusitis after injury suggests that intracranial infection can occur-indeed, usually does occur-through sinuses that are not inflamed. If this is true, then it follows that the local operation on the injured sinuses as suggested by Teachenor is based on a false premise.

In 1937 I reported before this Section the case of a man who had suffered from meningitis and left frontal aerocele three years after a motor-cycle accident (Cairns, H. (1937), J. Laryng, & Otol., 52, 589). During the meningitis, which was not severe, this man's left frontal sinus was explored and its mucosal ining was removed. In the posterolateral bony wall of the sinus there was a gap through which the soft tissues were seen to bulge. The argument advanced at the time was that, as the mucous membrane had been removed, the left frontal sinus would not be involved when the patient contracted an upper respiratory infection, and that therefore there was no further risk of meningitis. During the next eighteen months the patient had two heavy colds without any complication, but two and a quarter years after the operation (and five and a half years after the original head injury), he developed a pneumococcal meningitis and died. The meningitis supervened one month after a cold. At necropsy a small acute abscess was found in the left frontal lobe beneath the defect in the bony wall of the frontal sinus.

Local operation on the sinuses was ineffective in preventing meningitis in this case. Doubtless the mucous membrane of the sinuses regenerates quickly after removal.

Operation should provide for wide exposure of the dural surface of the accessory sinuses of both sides. I favour when possible the frontal flap and extradural approach, though the intradural approach of Taylor and Eden is doubtless equally effective in many cases. For most cases complete exenteration of the bony walls of the sinuses seems an unnecessarily mutilating procedure.

All these are operations of magnitude, and if performed in the first hours after the injury will usually need to be accompanied by blood transfusion. For this and other reasons I think it is better in most cases to defer repair of the dural defect until a week or two after injury, the patient meanwhile being kept on sulphonamides, with due care that he does not blow his nose or contract a cold. Wounds on the forehead or bridge of the nose should be closed in the first twenty-four hours after injury, and even when X-rays have shown that dural repair is necessary surgical intervention in the acute stage should usually be limited to débridement and closure of the scalp.

# A New Forehead Flap for Nasal Reconstruction

By John Marquis Converse, M.D.

Plastic Surgeon to the American Hospital in Britain.

This paper was illustrated by a film, demonstrating the operative steps and showing results obtained in a number of patients.

Following a correct diagnosis of the nasal deformity and an accurate estimation of the tissue loss some mode of repair must be considered. In some cases this is possible by the means of a local tissue shift to remedy a small defect. In many cases it is possible to replace a superficial defect by means of a free skin graft. However, when tissue loss is considerable, necessitating the reconstruction of the tip or the alæ of the nose, and in many cases of superficial defects unsuited for free grafting it is necessary to use a skin flap.

In a few favourable cases a flap from the surrounding tissue, of the nose itself or of the cheek may be used; in most cases, however, it is necessary to call upon a skin flap from a distance. The transfer of flaps from the chest, the arm, or the abdomen, means multiple stages and often an uncomfortable position for the patient. Furthermore the skin of these regions usually does not have the texture that permits the proper shaping of the nose. Their greatest disadvantage is the disparity in colour, which exists from the start and is often accentuated in the course of time.

A favourite method of repair in defects of the nose is by means of a forehead flap. This flap used in the ancient Hindu Rhinoplasty is one of the oldest of surgical procedures. Numerous modifications of this flap were made during the nineteenth century. In general an oblique forehead flap, giving added length was employed. Further lengthening of the flap was obtained with the introduction of Gillies' "up-and-down" modification.

The advantages of the forehead flap can be enumerated as follows: (1) Its contiguous availability. (2) Its good match in colour and texture. (3) Its excellent blood supply. These advantages follow the general principle that the reconstruction of a part can best be performed by using the part itself or the tissues in its immediate vicinity. It is particularly important in the reconstruction of a partial loss of the nose that the newly constructed part be blended with the remainder of the nose into a homogeneous feature.

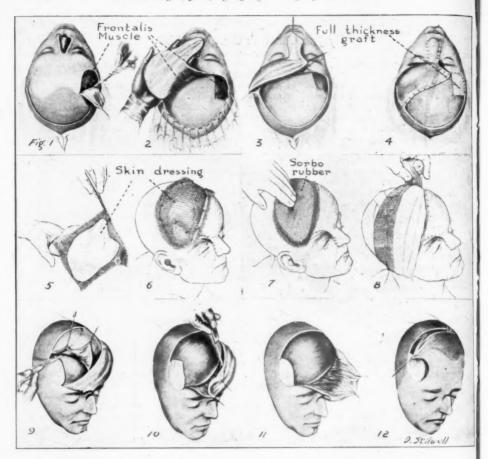
The disadvantages of the forehead flap are twofold: (1) The secondary deformity produced on the forehead. (2) The fact that most forehead flaps are open flaps presenting a raw surface open to infection and fibrosis. With the idea of diminishing these disadvantages I have devised a forehead flap, the steps of which are illustrated. The advantages of this flap are the following: (1) Scarring on the forehead is reduced to that portion of the flap which will serve in the reconstruction. The incisions made for the "carrying" portion of the flap are placed entirely behind the hairline. (2) The flap may be closed by folding it upon itself, thus avoiding the danger of infection. Fibrosis is reduced to a minimum. The flap can be unfurled easily and replaced into its original site without difficulty. (3) An abundant blood supply is provided by the wide base of the flap.

The disadvantage of this flap is the large raw area created after its elevation. It is minimized, however, by the use of a temporary Thiersch graft skin dressing which is removed before the return of the flap.

Operative procedure.—The portion of the flap which is destined to reconstruct the nasal loss is outlined on the forehead as far laterally as possible. It is then carefully dissected off of the frontalis muscle without injury to the latter (fig. 1). In this manner the normal motility and wrinkling of the forehead are preserved. A coronal incision is then made as far as, but respecting, the anterior branches of the temporal vessels on the opposite side.

The frontalis muscle is split along the medial edge of the permanent defect (fig. 2). The forehead flap is raised with the galea aponeurotica and the remainder of the frontalis muscle. In this way the chances of injuring the essential afferent and efferent vessels are minimized. The nasal portion of the flap is sutured into position. The forehead flap is then folded upon itself (fig. 3) so as to be completely closed (fig. 4). A full thickness graft removed from behind the rim of the auricle and as far back as the hairline will suffice to cover a moderate-sized defect. It gives the best type of repair. An intermediate thickness skin graft is applied to the retro-auricular region and gives a good secondary skin replacement. The remaining raw area on the head is covered by Thiersch graft skin dressings (figs. 5 and 6). A pressure dressing is applied taking care to avoid pressure over the folded flap (figs. 7 and 8).

Later the attachment of the forehead flap to the nose is divided, the skin dressings removed (fig. 9), and the closed flap is unfolded without difficulty (figs. 10 and 11) and returned to its original site (fig. 12) leaving a laterally situated defect covered by a good colour-matching full-thickness graft.







Repair of nasal defect by forehead flap. Forehead defect is placed laterally and is thus less conspicuous.

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Extensive use of Oestroform and Progestin B.D.H., both in private practice and in research units, has clearly established the fact that the administration of these sex hormone preparations produces a specific effect in every case associated with hypofunction of the ovarian follicle and of the corpus luteum respectively.

**OESTROFORM**, the natural estrogenic hormone standardised in international and in international benzoate units, is indicated for the relief of menopausal symptoms, delayed puberty, amenorrhoea, oligomenorrhoea, sterility and dysmenorrhoea due to uterine hypoplasia, pruritus and kraurosis vulvae.

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Carrel and Dehelly Military Medical Manuals, "The Treatment of Infected Wounds," 2nd Edition (1918), p. 24.

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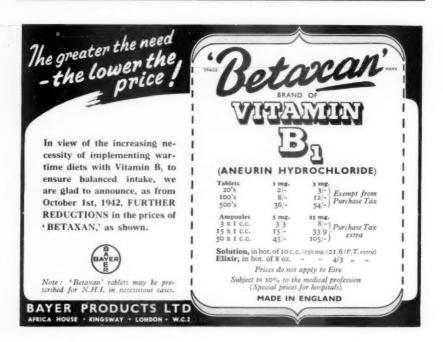
Milton 1 in 20, for example, has a pH of 8-89 Dakin's solution 1 in 10 (which has the same content of available chlorine and hence the same oxidising power) has a pH of 10-64. Milton (full strength) has a pH of 10-7. Dakin's solution (full strength), which has half the content of available chlorine, has a pH of 11-61.

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